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HE MINERALOGICAL MAGAZINE

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nnantite, a new manganese-rich chlorite from Benallt mine, Rhiw, Carnarvonshire.

By W. Campbell Smith, M.C., T.D., M.A., Sc.D.,
F. A. Bannister, M.A., F.Inst.P., and Max H. Hey, M.A., D.Sc.
Department of Mineralogy, British Museum.

[Read March 28, 1946.]

HE manganese ores of the Benallt mine are pervaded by an orange-coloured mineral which occurs very poorly crystallized as patches and small specks e matrix. Less commonly it occurs as minute flakes in the ore and sometimes constituent of very thin veins which traverse the ore. In some specimens nineral is better developed. It then shows a good cleavage and resembles in arance in thin section a weakly pleochroic mica or chlorite. Patches of this ral in the matrix frequently enclose very small rounded garnets which are ved to be spessartine.

1932 Dr. A. F. Hallimond examined some sections of ore from the old llt mine for Dr. C. A. Matley and suggested that one of the constituent rals might be a manganiferous chlorite.[1] Dr. A. W. Woodland[2] identified as low chlorite an important secondary mineral in the manganese ores of the mines, Nant-y-Gadwen, a mile SW. of the Benallt mine. This he regarded nanganiferous variety of chlorite. He observed its alteration in the weathered nd noted that the final product of its weathering was a black earthy oxide cit., p. 209) which he considered was pyrolusite (loc. cit., p. 212).

part of the study of the manganese ores of the Benallt mine, undertaken in boration with Dr. A. W. Groves, it became important to identify with inty the ubiquitous orange-coloured mineral and to endeavour to determine anganese content.

opportunity to do this presented itself when it was found that the walls in white and pale pink veins traversing massive ore from the Ty Canol ne were lined in places with small (0·5 mm.) flakes of an orange-brown, ceous mineral which seem undoubtedly to be the same as the orange-coloured ral pervading the ore itself.

ne of these veins, 5 mm. thick, runs for about a foot through a block of the

. A. Matley, Quart. Journ. Geol. Soc. London, 1932, vol. 88, p. 263.
. W. Woodland, Proc. Geol. Assoc. London, 1939, vol. 50, p. 209. [M.A. 8–250.]

massive ore. Portions of this vein were chipped out and separated from adhe fragments of ore. The vein minerals were determined by examination of sections, refractive index, density, simple microchemical tests, and, for thre the constituents, by X-ray photographs. The main constituent is an aggre of minute flakes of a colourless mica and analcime. X-ray photographs of a g of the aggregate show powder lines and spots which are attributable respecti to fine-grained paragonite and to analcime crystals. Banalsite is present, par larly in some thinner veins. Some of the banalsite crystals are invaded by fine-grained aggregates of colourless mica, and it is possible that the analc paragonite aggregates result from the replacement of banalsite ($BaNa_2Al_4Si_4$ with elimination of barium. Some compact, pinkish-buff grains with fi texture are identified by X-ray photographs with ganophyllite.[1] Some calci present, and there are a few small, colourless, highly birefringent crystals wh are probably tephroite. Small orange-red crystals, yellow in thin section, w high refractive index ($n > 1{\cdot}84$), uniaxial, optically negative, are pyropha

The orange-brown chlorite occurs in the body of the vein as well as on its ed In thin section it shows a good cleavage and is pleochroic with γ' (parallel to cleavage) xanthine-orange, α' orange-buff.[3] Absorption $\alpha < \beta = \gamma$. Flakes s a uniaxial, negative optic picture. Refractive indices, measured in sodium-l by the Becke line method, are α $1{\cdot}646 \pm 0{\cdot}001$, $\beta = \gamma$ $1{\cdot}661 \pm 0{\cdot}001$.

A few flakes of the chlorite were selected for X-ray examination. X-ray ph graphs of single crystals and powdered flakes identify the mineral as a membe the chlorite family; moreover, the powder photographs are identical in patt with those of thuringite from Schmiedefeld, Thuringia,[4] though the new min has larger cell dimensions, namely a 5·43, b 9·4, c' 28·5 Å.

The value obtained for the corrected density, determined on part of the pu sample used for the chemical analysis, is $D_4^{16} = 3{\cdot}06 \pm 0{\cdot}01$.

The preparation of a sample for chemical analysis was made in the first place selecting from the veins chippings which contained visible chlorite. These w broken down in a steel mortar and subjected to density and magnetic separati the chlorite being readily attracted by the electro-magnet. From the concentr so obtained about 30 mg. of pure material was separated by careful hand-pick under the microscope. A less pure sample of 40 mg., known to contain appreci amounts of banalsite and opaque ore-minerals, was used for a preliminary analy and for the determination of the water and of the state of oxidation. The res obtained in the preliminary analysis served as a guide in planning the anal of the purer sample. Alkalis were not determined.

The mineral was opened up by a perchloric acid attack, the silica dehydra with perchloric acid, and the barium then determined as sulphate. The alumini and iron were precipitated with hexamethylene tetramine (to avoid contami tion by Mn), reprecipitated once, then the iron was determined colorimetric with sulphosalicylic acid in ammoniacal solution, and aluminium and iron

[1] Ganophyllite was found in the neighbouring Nant mine by Sir Arthur Russell in 1 (this vol., p. 234).

[2] Identification confirmed by X-ray photograph and manganese test. Pyrophanite not previously been recorded from the British Isles.

[3] R. Ridgway, Color standards and color nomenclature. 1912.

[4] W. von Engelhardt, Zeits. Krist., 1942, vol. 104, p. 145. a 5·37, b 9·30, c 14·10 Å., β 97°

ıted together from this solution and weighed as the 8-hydroxyquinoline
For some unknown reason, a clean crystalline precipitate of $NH_4(Mn,Mg)$
$5H_2O$ could not be obtained for the determination of manganese and
ıesium, so the unsatisfactory precipitate was dissolved and the manganese
zed to permanganate and so determined. For the magnesium, it was neces-
to rely on a value obtained from the less pure sample, by precipitating the
ganese in the filtrate from the aluminium and iron with ammonium sulphide,
letermining the magnesium as 8-hydroxyquinoline derivative after oxidation
e sulphide. Calcium was sought for in the filtrate from the magnesium but
ıot found. Titanium was tested for in the aluminium-iron precipitate and
n to be absent. Water was determined by the Penfield method on a 5 mg.
on of the less pure sample.

e state of oxidation being of considerable interest, 10 mg. of the less pure
le was reserved for its determination. This determination raised some
ulties; on the one hand, the mineral might contain all its manganese as MnO
part of the iron as FeO, or, on the other, part of the manganese might be
nt as Mn_2O_3, and only a single portion could be spared for the determi-
n. After some preliminary experiments, the following method was found
factory: the mineral was attacked in the cold with a mixture of 5 ml. con-
ated HCl, 5 ml. M/200 ICl in concentrated HCl, and 1 ml. M/200 KI, in a
pered flask; after four days no unattacked mineral remained, and the solution
titrated (against a blank) with M/400 KIO_3, using CCl_4 as indicator. With
arrangement, any Fe″ present would reduce part of the ICl to iodine, while
Mn‴ would oxidize part of the free iodine (produced by the KI addition) to
special tests proved that the solutions of iodine and ICl in concentrated HCl
satisfactorily stable. The result showed that, within the probable experi-
tal error of about 0·2 %, FeO and Mn_2O_3 are both absent.

ıe analyses of the two samples are given in table I, together with the empirical
-cell contents (column C) derived from the analysis of the purer sample
ımn A), the X-ray measurements, and the density. The probable error figures
e given only take account of the probable error of the physical measurements

BLE I. Chemical analyses and empirical unit-cell contents of pennantite. A, purer le; B, impure sample; C, empirical unit-cell contents of the purer sample.

	A.	B.		C.	
SiO_2	22·64	23·43	Si	10·5	
Al_2O_3	18·60	18·76	Al	10·2	
Fe_2O_3	4·43	6·80	Fe‴	1·5	38·8 ±0·8 (ΣR)
MnO	38·93	32·46	Mn″	15·3	
MgO	[1·48]	1·48	Mg	1·0	
BaO	1·33	7·40	Ba	0·3	
H_2O	[9·40]	9·40	OH	29·2	69·7 ±1·4 (ΣO,OH)
			O	40·5	
	96·81	99·73			

sity and cell-dimensions). It is difficult to assess the effects of impurities or ytical errors on the empirical unit-cell contents quantitatively, but some lations have been made, and show that: if part of the MnO and Fe_2O_3 are nt as ore, the oxygen plus hydroxyl figure (ΣO,OH) is raised, improving the ement with the ideal formula, while the sum of the cations (ΣR) is only

slightly affected; if the barium is taken to be present as banalsite (6%), the e
on Σ(O,OH) and ΣR is similar; if the whole or part of the deficiency in the
mation is due to under-estimation of the water, Σ(O,OH) and the hydroxyl f
are increased, but ΣR is decreased. None of these effects is very great, and
quite clear that no probable error in the analysis and no probable impurity in
sample can seriously affect the empirical unit-cell contents given, but that v
the probable analytical and physical errors are taken into account the
probable value for the oxygen plus hydroxyl figure (ΣO,OH) is 72, and for
sum of the cations (ΣR) 40. Hence the repeat may be given as $(Mn,Al)_{24}(Si,Al)_{2}$
$(OH)_{32}$, with Si : Al_{iv} near 1·9, and minor amounts of Fe‴ and Mg.

The low MgO, low SiO_2, high Al_2O_3, and very high MnO contents shown by
chemical analysis distinguish this chlorite very clearly from all hitherto descr
manganese-bearing minerals of the chlorite family and from manganophyl
On the other hand, the empirical unit-cell contents calculated from the ana
show a very close analogy with the thuringite formula $(Mg,Al,Fe)_{12}(Si,Al)_{8}$
$(OH)_{16}$ given by W. von Engelhardt for thuringite from Schmiedefeld, Thur
(loc. cit., p. 146), and the analogy accords with the evidence of the X-ray ph
graphs. It would appear, therefore, that this chlorite from the Benallt min
a new mineral analogous to thuringite, but containing MnO in place of the

The names manganchlorite (Hamberg)[1] and manganese-chlorite (Eckerma
have been applied to chlorites containing only a low percentage (1·02–2·28) M
so it is desirable to avoid the use of either of these names for a chlorite so ric
manganese as the mineral here described, and we therefore propose for
new name, *pennantite*, after Thomas Pennant (1726–1798), the Welsh trave
zoologist, and mineralogist.[3]

[1] A. Hamberg, Geol. För. Förh. Stockholm, 1890, vol. 12, p. 580.

[2] H. von Eckermann, Geol. För. Förh. Stockholm, 1927, vol. 49, pp. 450–454, and
vol. 66, pp. 721–724. [M.A. **3**–474, **9**–256.]

[3] W. Campbell Smith, The mineral collection of Thomas Pennant (1726–1798). Min. M
1913, vol. 16, pp. 331–342.

rhodonite and tephroite from Treburland manganese mine, rnun, Cornwall; and on rhodonite from other localities in Cornwall and Devonshire.

By Sir Arthur Russell, Bart.

[Read March 23, 1944.]

Treburland manganese mine, Altarnun, Cornwall.

(Six-inch Ordnance map, Cornwall, 22 NW., 1907.)

f the many small manganese deposits which have in the past been worked in both Cornwall and Devonshire that of Treburland is from the mineralogical of view by far the most remarkable, its especial interest being due to the ty of minerals which it has afforded and to the fact that it and one other he only manganese deposits in the west of England which are known to the contact of igneous and sedimentary rocks and which have consequently vitally affected by contact metamorphism.

e following observations are based on frequent visits to the spot since the 1906, when I first stumbled across the locality, which, strange to say, has received very cursory mention by the Geological Survey and has altogether ed mention in mineralogical literature.[1] The old workings, which are of small extent and shallow, are situated on the south side of the river Lynher t midway between the ruined corn mill of Trevague and Treburland home- in the parish of Altarnun, and $1\frac{1}{2}$ miles by road from the village of Five s. At what date the deposit was discovered I know not, but between the 1887 and 1890 the mine produced 470 tons of manganese ore (pyrolusite) was then worked in conjunction with the adjoining Treburland tin and am mine and by the same adventurers. The name New Phoenix was given to oint concern by the manager, Captain Vercoe, in consequence of the flippant ncomplimentary name, Wheal Flop, by which the tin mine was known to the rs. Close to the manganese workings are the ruins of a tin-stamping mill and e walls of this are built blocks of rhodonite. The appearance of this mill sts that it is of some antiquity and the water-wheel which drove it was fed water by a leat, an underground portion of which appears to have traversed anganese deposit; hence this may very well have been discovered during the ruction of this watercourse. Most if not all of the dump material, which I systematically broken up and examined, appears to have been raised during 887–1890 working. Some 120 yards to the south there is situated the old rland tin and wolfram mine, alias Wheal Annie or Wheal Flop, which ed on true lodes traversing both granite and killas, and a part of which has tly (1942) been again set to work.

fortunately nothing can now be seen of the actual manganese deposit, which ist within the killas or contact-altered sedimentary Upper Devonian slate

[1] he occurrence of rhodonite at Treburland was communicated by me to the late Mr. J. H. s and is mentioned in his List of minerals found in Cornwall and Devon, with notes mentary to the author's 'Handbook'. Journ. Roy. Inst. Cornwall, 1911, vol. 18, p. 456.

(Woolgarden phyllite of the Geological Survey) close to its junction wit
main Bodmin Moor granite mass: the distance to the nearest granite at the su
being about 120 yards and underground, allowing for the dip, probably very
siderably less. The dump material, which is very fresh, makes it clear, how
that it is a bedded deposit conforming in some respects to the type usually
with in east Cornwall and Devonshire. The ore lies within or in contact w
band of highly calcareous calc-silicate rock, originally an impure limestone, w
has been intensely metamorphosed by the granite, giving rise to a varied
extremely interesting assemblage of minerals. Aplite veins were also met wi
the workings and evidently traverse the calc-silicate rock as at Meldon in De
shire. The hard silicate manganese ore consisting of rhodonite, bustamite
tephroite occurs in the form of loose more or less rounded blocks which wh
situ had packed between them soft pyrolusite, the ore sought for. There
actually two pockets, probably part of the same bed, which were worked ou
of these was beneath the dumps on the north or right-hand side of the road w
the calc-silicate rock is still visible in an overgrown pit, the other on the so
left-hand side of the road. Both pockets were reached by a short and very sha
level driven from the marshy ground by the river Lynher, the depth now
exceeding 25 feet.

Speculating on the origin of the deposit, it seems safe to assume that
manganese was originally deposited as the carbonate rhodochrosite and
obvious that the present assemblage of silicated manganese minerals is the re
of contact metamorphism, while a few are of secondary origin or altera
products. In some of the west of England deposits which have not been subje
to metamorphism the manganese still retains its carbonate form, in part at
rate, though much has been altered to oxide. Examples of this are well see
three manganese mines in Devonshire: Chillaton and Hogstor mine, Mi
Abbot; Scanniclift Copse mine, Doddiscombsleigh; and Stancombe mine, Bo
Tracey. At Haytor iron mine, Ilsington, Devonshire, the well-known magn
beds were likewise almost certainly originally carbonate and, as at Treburl
were intensely metamorphosed by the upheaval of the adjoining Dartmoor gra
Some stress has been laid by the Geological Survey on the fact that many of
west of England manganese deposits have intrusions of greenstone in t
immediate vicinity, and in this respect Treburland is no exception, for greens
outcrops at a very short distance from the workings; there is, however
evidence that I can see to suggest that there is any connexion between the

The following minerals have so far been identified on material obtained from
small dumps, the manganese minerals in particular forming extremely fine s
mens. Those marked with an asterisk are from the calc-silicate rock. Of the met
minerals only magnetite and pyrrhotine are at all abundant. Psilomelane, com
in many of the Cornwall and Devonshire manganese mines, appears to be abs

Rhodonite	Galena	Magnetite	Amphibole
Bustamite	Blende	Quartz	*Garnet (Andradite and Spessarti
Tephroite	*Pyrrhotine	Calcite	Idocrase
Bementite	Chalcopyrite	Fluorite	*Axinite
Pyrolusite	Malachite	Apatite	*Apophyllite
Rhodochrosite	Pyrite	Albite	Lepidolite
Manganocalcite	Marcasite	Pyroxene	*Chlorite
Molybdenite	*Arsenopyrite	*Wollastonite	

Rhodonite.

ıe mineral is extremely abundant, forming the greater proportion of two of the l dumps, and loose masses are also to be found everywhere scattered over the ıce in the proximity of the workings. It forms large very hard crystalline ›what rounded blocks externally altered to a thin black crust of pyrolusite, ›locks being in the exact condition in which they lay loosely in the bed. It ›s in texture from fine-grained to very coarse in which the crystal cleavages 10) and *M* (1$\bar{1}$0) sometimes attain a length of 6½ cm. very coarse rhodonite consists of interlocked cleavages markedly curved surfaces, the colour varying from rose- to brownish-pink, while towards the exterior of the masses nteresting stage in alteration is shown—the pink colour almost disappeared and the mineral, though retaining its slucency, has become nearly colourless with a fibro-lamellar ›ture, the successive surfaces of the cleavages and the minute sverse cracks being coated with brown and black films of ›lusite. In another beautiful variety, which is rare, the ponent rose-pink cleavage crystals have assumed a definite ating and somewhat fibrous form. The colour of the finer- ned mineral, which is by far the most abundant, varies from pink through various shades to deep vinaceous, some essing a most unusual and beautiful purplish vinaceous which, as far as I am aware, is peculiar to this locality. ge slabs of all the varieties and particularly of the latter, suring up to 10×7 inches which have been sliced and shed, form extremely beautiful specimens; the purplish ıceous groundmass showing here and there faint purplish- patches, while traversed in all directions by infiltration lets of black pyrolusite from which spread stains of light brown. Towards margin of many of the masses the rhodonite passes into brown tephroite, the -grained rhodonite also including large cleavage crystals of tephroite; others sist of a brown to slightly pinkish coarsely crystalline intimate mixture of lonite, bustamite, and tephroite, while in others again the rhodonite is inter- vn with fine-grained pale-green pyroxene. In some of the Treburland lonite, but not all, the beautiful pink colour of the freshly fractured surfaces ls to become slightly brownish on exposure to light, likewise the greenish ur of the fine-grained pyroxene intimately associated with the rhodonite ›mes a nondescript greyish-brown.

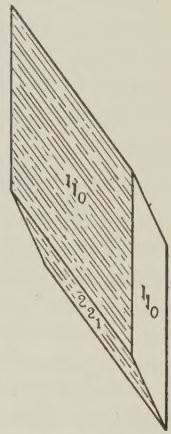

FIG. 1. Crystal of rhodonite from Treburland manganese mine, Cornwall.

arely joints in the crystalline mineral are covered with small, definite, though he most part cleaved and interlocked crystals which attain a length of 7 mm.; being the first locality in Great Britain which has afforded crystallized lonite. The crystals, which are pale pink and sometimes quite transparent, mble in habit very acute rhombohedra. They are simple combinations of 10), *M* (1$\bar{1}$0), and *k* ($\bar{2}$21) (fig. 1) and thus closely resemble one of the acute s of crystals from the Harstig mine, Pajsberg, Sweden, figured by G. Flink.[1] faces *m* (110) with their perfect cleavage and pearly lustre are usually upper-

[1] G. Flink, Zeits. Kryst. Min., 1886, vol. 11, pl. 9, fig. 29.

most; those of M $(1\bar{1}0)$ and k $(\bar{2}21)$ are deeply striated parallel to their mu intersections from repetition of the two forms. In consequence of the repeti striae a certain amount of rounding results and the m (110) cleavage face often than not presents a canoe-shaped outline. On one specimen the face $(1\bar{1}0)$ and $(\bar{2}21)$ are curiously plated with a thin film of brassy pyrite. The a obtained from the measurement of two minute but uncleaved crystals $(110) : (1\bar{1}0) = 92° 28'$ and $(1\bar{1}0) : (\bar{2}21) = 31° 9'$. The mineral is optically posit as is to be expected with a lime content of only 7 %; when rich in lime, a bustamite, it becomes negative. The specific gravity of the pale-pink coar crystalline rhodonite from the specimen yielding the measured crystals is 3 All of the Treburland rhodonite examined effervesces decidedly with acid. analysis by Dr. J. A. Smythe on material from the best crystallized specimen i follows and shows the mineral to be a normal iron-rich rhodonite in which z is absent.

SiO_2.	MnO.	FeO.	MgO.	CaO.	CO_2.	$H_2O(+)$.	$H_2O(-)$.	Tot
46·65	37·00	7·65	1·67	7·00	0·09	0·52	0·05	100

The Treburland rhodonite sometimes contains embedded specks of gar (spessartine), galena, molybdenite, and on joint faces chalcopyrite and trace malachite.

Bustamite.

The presence of this mineral was discovered by Professor C. E. Tilley as result of a visit with me to the locality in 1944 and will be described by him i separate paper dealing especially with its paragenesis (this vol., p. 236). It occ intimately associated with both rhodonite and tephroite, and more rarely in nea pure masses composed of coarse, somewhat fibrous cleavages of a pinkish-b colour very near the vinaceous-buff of R. Ridgway. The purest and finest specime were obtained from the ore pocket on the south side of the road, that is, fr the workings nearest the granite.

Tephroite.

Tephroite, though not nearly so abundant as rhodonite, with which it is in mately associated, occurs in considerable quantity. In its purest form it prese very dark-brown fine-grained crystalline masses often bordering rhodonite, th being, however, usually a sharp boundary between the two minerals. More rar it forms large dark-brown cleavage crystals up to 3 cm. but with no definite ou line shape, set in a groundmass of medium-grained pink rhodonite often admix with pinkish-buff bustamite. In other specimens tephroite forms the groundm with here and there large cleavage crystals of deep pink rhodonite. Again, th are many large masses of a coarse-grained intimate mixture of rhodonite, bus mite, and tephroite, which vary in colour through shades of pink and brown.

The lustre is greasy and the fracture conchoidal. Under the microscope, t fine-grained tephroite is seen to consist of about equal proportions of translu pale smoky-brown to yellowish, and opaque almost black particles—this, ho ever, is apparent rather than real, for, when crushed the grains are of a unifo smoky-brown to yellowish colour, the difference while in mass being due to t thickness of the particles on fracture. There are two cleavages at right ang the prominent one which is often distinct is parallel to (010) and rudely striat

parallel to (001) is smooth and much less conspicuous. Tephroite is biaxial negative, the refractive indices being all about 1·74. 2V is high, about 60°. specific gravity of the pure fine-grained mineral analysed is 4·07.

ıe following analysis by Dr. J. A. Smythe shows the mineral to be an iron-tephroite in which zinc is absent. In preparing the sample for analysis a very l quantity of rhodonite and pyrolusite was separated by bromoform, the product being entirely magnetic. The only other element detected was a of boron. To Mr. F. A. Bannister I am indebted for a confirmatory X-ray ɔgraph.

SiO_2.	MnO.	FeO.	MgO.	CaO.	CO_2.	$H_2O(+)$.	$H_2O(-)$.	Total.
29·90	53·26	13·01	1·77	1·57	0·20	0·65	0·07	100·43.

Bementite.

·is mineral is rare at Treburland. It occurs in two ways. As sharply defined ·lel veinlets up to 6 mm. across, traversing masses of fairly coarse crystalline ɔnite, the colour being brownish-yellow, the Dresden brown of R. Ridgway. hemispherical on joints in rhodonite covered with crystals of that mineral. hemispheres up to 4 mm. in diameter are formed of radiating translucent nish-yellow foliae with pearly lustre, thin cleavage flakes being light yellow transparent. The hemispheres are interspersed between the crystals of onite and little sheets of manganocalcite. One specimen of rhodonite was l which, when broken, shows, on the two halfs of an open joint, botryoidal res of partially altered bementite. These spheres are chamois-coloured and become soft, but still retain their foliated radiating structure. Upon them ninute globular crystals of rhodochrosite and some black shining botryoidal lusite, while underlying them are well-defined crystals of rhodonite. Drusy s of a white to slightly pink undetermined mineral sometimes coat the spheres mentite when lining cavities. Bementite is optically negative with a specific ıty of 2·83, which is a good deal lower than that of the Franklin Furnace ral. It is hoped that it will eventually be possible to collect sufficient pure ·rial for a complete analysis without destroying the few specimens which have r been found.

Pyrolusite.

ıis mineral, which formed the ore worked, occurs as black, shining, rather aceous masses, also earthy sooty-black and brown, and more rarely as glossy botryoidal aggregates. Much of it appears to result from the alteration of onite and nearly all the larger masses have a core of that mineral.

Rhodochrosite and Manganocalcite.

ıodochrosite has been identified on two specimens only in the form of ıte $\frac{3}{4}$ mm. pale pink spheres built up of successive crystal layers forming tes, the pole of each being a smooth bright face (0001), and also with these inute translucent dark brownish-red globules, on crystals of rhodonite with ntite. The specific gravity is 3·51. Manganocalcite is seen to be present, iated with the manganese silicates, in thin sections; more rarely it is visible e eye in the form of small, practically colourless sheets on the joints showing als of rhodonite.

Other minerals.

Of the metallic minerals *Molybdenite* is the most interesting. It occurs r
as minute very bright flakes embedded in the pale pink crystalline rhodonit
also as similar flakes between the basal partings of the coarse brownish-gre
brown pyroxene (manganhedenbergite). Embedded flakes of molybdenite h
also been noted in the rhodonite from two of the other localities described i
paper. *Galena* occurs rarely as small bright cleavages up to 2½ mm. embedd
both rhodonite and tephroite. *Blende* has been observed once only in m
quantity on a joint in rhodonite. *Pyrrhotine* is relatively abundant, assoc
with pyroxene and amphibole, and more particularly in the dark calc-si
rock. *Chalcopyrite* occurs somewhat rarely in patches, intimately associated
rhodonite, bustamite, and tephroite, and I have one specimen of rhodonite
joint face of which there are chalcopyrite and traces of malachite with p
marcasite, galena, blende, spessartine, garnet, and idocrase. *Pyrite*, thoug
abundant, forms small masses composed of rude cubes with quartz; it is
disseminated as specks through the dark calc-silicate rock, &c. *Marcasite*
been identified, on one specimen only, as a thin crust on rhodonite with chal
rite, &c. *Arsenopyrite* is rare in the form of tin-white short prismatic crystals (
(012) up to 3 mm. in length, embedded in dark calc-silicate rock. *Magnetite* o
as large, very dense, and rather fine-grained crystalline masses streaked here
there with brownish-yellow garnet.

Fluorite and *Apatite* are present as minute colourless grains in the ap
veins. Two forms of *pyroxene* have been identified. Diopside as minute
green crystals in the calcite-garnet-filled vesicles in the calc-silicate rock descri
under garnet; and in fine-grained pale greenish form intergrown with f
grained rhodonite, the green colour of this speedily turning to a nondesc
brown after exposure to light. Manganhedenbergite as large translucent brown
green to brown lamellar cleavages measuring up to $3 \times 1\frac{1}{2}$ cm. It is extern
altered to a rusty brown and coated with films of black manganese oxide, fi
of this permeating both partings and cleavages. The characteristic basal parti
are very distinct as also the cleavages on prism and clinopinacoid. Under
microscope the mineral is seen to be full of dark inclusions, and here and th
between the partings are numerous minute scales of molybdenite. This pyrox
was determined as being manganhedenbergite by Professor C. E. Tilley and
analysis of it appears in his paper dealing with bustamite and its paragen
in the pages of this magazine (p. 237). *Wollastonite* forms thin layers in
highly calcareous portions of the calc-silicate rock and good specimens h
been obtained showing the usual radiating aggregates of white silky fibre
to 1½ cm. across, and between which is intergrown yellow garnet. *Amphi*
occurs as blackish-green coarse cleavages associated with pyrite and pyrrhot
also rarely as fibrous asbestiform bands. A yellow *garnet* definitely refer
to spessartine occurs in the form of very small clear honey-yellow concho
fractured aggregates embedded in the pale pink crystalline rhodonite; and als
small sparkling honey-yellow to dark yellowish-brown crystals covering
surface of somewhat altered pyroxene (manganhedenbergite). These cryst
which attain a diameter of 1 mm., are simple but very unsymmetrical trapezohe
(211) the faces of which, though extremely bright, are mostly deeply stria

rallel to (110) from oscillation with that form. One of the dumps yields a ıded dark grey contact-altered calc-silicate rock full of cinnamon-coloured net which has the characters of a calcium-iron-manganese-andradite. This net is present both as strings and in vesicles averaging 5 mm. in length, elongated the direction of the foliation of the rock. The vesicles, in addition to garnet, ıally contain calcite and more rarely diopside, apophyllite, and chlorite, and, en calcite-filled, both garnet and diopside have been able to form minute but inite crystals. There also occur considerable bands almost entirely composed this brownish to cinnamon-coloured garnet, the joints of which are covered h small bright flattened trapezohedra associated with axinite. *Idocrase* is rare; occurs with wollastonite and pyrrhotine as long columnar brownish-yellow ms up to $6\frac{1}{2} \times \frac{1}{2}$ cm. embedded in dark grey calc-silicate rock, also in one e as smaller prismatic aggregates with spessartine, &c., directly on rhodonite. *inite* is not very common, but one or two masses were obtained showing layers arge dark violet-brown shining lamellae up to 3 cm. in length, associated with ıdolite in rusty bands of the calc-silicate rock; also one specimen in which the nite is associated with small trapezohedra of cinnamon-coloured garnet. An ılysis of this axinite would be interesting, as it may well be sufficiently rich manganese to be classed as a manganaxinite. The occurrence of *Apophyllite* s already been mentioned under garnet and is one of the minerals identified occupying the vesicles in a peculiar form of calc-silicate rock. It forms colour- s (001) cleavages with iridescent pearly lustre and is associated with calcite, &c. *pidolite* forms very fine-grained lavender-coloured patches, which under the croscope are seen to consist of very minute scales, and is associated with white spar. It occurs both in the calc-silicate rock and in the aplite, or rather at the ıtact of the two, and exactly resembles the lepidolite which is found under ıilar conditions at Meldon, Okehampton, Devonshire, both in the aplite quarry l in the Southern Railway quarry.

Pencrebar manganese mine, Callington, Cornwall.

(Six-inch Ordnance map, Cornwall, 29 SW., 1907.)

It is rather remarkable that collections of British minerals have never contained lly showy specimens of rhodonite, although the locality about to be described s been known for nearly 150 years and has yielded specimens equalling both in ıuty and size any that have been found either in Russia or elsewhere. The ality is situated on the main Callington to Liskeard road, $1\frac{1}{4}$ miles south of lington, just in Pencrebar South Wood where it abuts on the road. Manganese rolusite) was worked here prior to 1800 from pits a few feet deep in hard bands chert containing much red jasper in Culm Measure slate. From the Philip shleigh collection I have a polished specimen of rhodonite obtained from here ıut the year 1800. John Mawe visited the locality about the year 1816, and nes Sowerby in his British Mineralogy (1817) figures a specimen of rhodonite en to him by Mawe, who also supplied a description of the occurrence.[1] Mawe s he obtained many beautiful specimens, equalling the Siberian, from masses r a foot in size, at a depth of about six feet from the surface. The locality is

[1] J. Sowerby, British mineralogy. 1817, vol. 5, pp. 253–254, plate 536.

called Creva Wood by T. Hogg in his Mineralogy of Cornwall 1825,[1] and is referred to as a manganese quarry 1½ miles south-west of Callington by W. Phillips in his Mineralogy (1823);[2] and as a manganese quarry 1½ miles south-east of Callington by R. P. Greg and W. G. Lettsom (1858).[3] Connected with shallow workings in the wood, an adit level which is still open enters from the road-side and from the mouth of this in 1931 and subsequently I have removed very large masses of rhodonite, one measuring 2×2×1 feet and weighing over 2 hundredweight. These on being sliced and polished have yielded magnificent slabs of mottled light and dark rose-pink rhodonite with irregular patches of deep greyish-black chert: some specimens also show small blotches of orange-cinnamon-coloured rhodonite in the pink mineral, the contrast of tints being extremely beautiful. For the most part the mineral has a uniform very fine-grain and appears exceedingly pure save for an external coating of pyrolusite and sometimes infiltrated in cracks filled with that mineral. Very rarely minute flakes of molybdenite and crystals of chalcopyrite occur embedded in the rhodonite. The freshly fractured surfaces of the Pencrebar rhodonite do not tend to become brownish on exposure to light. It seems quite probable that the mineral is present here in sufficient quantity and at such shallow depth as to be worth working for ornamental purposes.

Lidcott manganese mine, Laneast, Cornwall.

(Six-inch Ordnance map, Cornwall, 16 NW., 1907.)

This interesting old mine is situated on the north-east edge of Laneast Down 360 yards south-east of Lidcott farm in the parish of Laneast. It had been at work for many years prior to 1826, in which year it was taken over by the Lidcott Manganese Company.[4] In 1830 the mine was described by Henry S. Boase, who gives a brief but interesting account of it.[5] He states that it had been a profitable undertaking and the workings were then 20 fathoms deep, the ore being confined to a siliceous bed striking north-east and having a width of about 12 fathoms. This bed is enclosed in black shales and purple- and chocolate-coloured grits belonging to the Lower Culm Measures. The ore consists of pyrolusite with rhodonite and rhodochrosite and lies in pockets and strings in hard chert. The earliest working consisted of a large cavern-like excavation with many ramifications, open to the day, and which is still accessible and well exhibits the nature of the deposit. Later it was worked by shafts, of which there are several, communicating with an adit-level opening from the stream bottom to the north-east. The mine was last worked between the years 1875 and 1881 in conjunction with Westdownend farther to the north-east. From one of the overgrown dumps I obtained in 1936, and subsequently, several large blocks of rhodonite associated

[1] T. Hogg, A manual of mineralogy; in which is shown how much Cornwall contributes to the illustration of the science. First edition, Truro, 1825, p. 88.

[2] W. Phillips, An elementary introduction to the knowledge of mineralogy. Second edition, 1819, p. 184.

[3] R. P. Greg and W. G. Lettsom, Manual of the mineralogy of Great Britain and Ireland, 1858, p. 294.

[4] H. English, A compendium of useful information relating to the companies formed for working British mines. 1826, pp. 40, 41, 43, 105, 106.

[5] H. S. Boase, Contributions towards a knowledge of the geology of Cornwall. Trans. Roy. Geol. Soc. Cornwall, 1832, vol. 4, p. 233.

ith rhodochrosite, grey chert, and chocolate-coloured grit, which on being iced and polished have yielded handsome specimens. The rhodonite is rose-nk and fine-grained with rather coarser patches of an orange-cinnamon colour, nd is intimately intergrown with areas of paler pink rhodochrosite showing stinct and much coarser cleavage, both minerals sometimes containing blebs glassy quartz, while ramifying through the grit there are veinlets of nearly hite manganocalcite. The specific gravity of the rhodochrosite is 3·6, and it is mpletely soluble in acid. It may here be mentioned that the depth of the pink lour shown by rhodochrosite and manganocalcite affords no criterion of the gh or low manganese content, for it is found that the very slightly pinkish or nkish-brown mineral is often true rhodochrosite, accepting 50 % of manganese rbonate as being the dividing line between the two minerals. As P. Krieger, wever, has shown,[1] both the specific gravity and refractive index mount with e increase of manganese and thus afford evidence as to whether the mineral all be classed as manganocalcite or rhodochrosite. The Lidcott rhodochrosite comes somewhat yellowish-brown on exposure to light, and it is probably owing admixture with this mineral that the rhodonite from Treburland and Week ave the same tendency. The only other minerals observed on the dumps are uartz and a little pyrite.

Higher Truscott manganese mine (Wheal Truscott), St. Stephens by Launceston, Cornwall.

(Six-inch Ordnance map, Cornwall, 16 NE., 1907.)

Manganese, in the form of pyrolusite, was extensively worked close to the amlet of Higher Truscott in the early part of the last century, and in more recent mes returns of manganese ore from here are given under the heading of St. tephens by Launceston. Thomas Spargo reports in 1865 that an adit was being riven to cut the lode, which looked well; in 1868 he mentions the adit being 0 fathoms deep, but the mine abandoned. The last working seems to have been 1 1876–1877 when the official returns are given as 540 tons of brown haematite, f which 400 tons contained 15% of manganese. This so-called brown haematite as probably magnetite. Very little evidence now remains to indicate the site f the former operations and it is only within the last two years that I have been ble definitely to locate the spot, which lies directly north-east of Higher Truscott amlet and between it and the north end of Cannapark Wood. Here, as the result f the recent ploughing up of the pasture field nearest Higher Truscott, depressions n the ground, caused by subsidence, were exposed, surrounded by considerable uantities of pyrolusite with quartz, clearly the result of mining operations, hile a little farther north-east in the north end of Cannapark Wood there are emains of old workings or rather dumps which contain magnetite with pyrite nd some pyrolusite evidently from a bedded deposit. At 600 yards to the south nd close to the railway there is a large quarry-like excavation which is marked n the six-inch map as Higher Truscott mine. No manganese is to be seen here nd the working suggests that it was limestone which was quarried. Though no nger visible, there is some evidence of an adit-level having been driven from this xcavation north, either to the manganese workings or to Cannapark limestone

[1] P. Krieger, Amer. Min., 1930, vol. 15, pp. 23–29. [M.A. 4–274.]

quarry. The manganese deposit at Higher Truscott is probably a bedded one a in part very quartzose; whether the magnetite occurs in the same bed or in anot it is impossible to say. The enclosing rocks are Lower Culm chert, shales, a grits, with a sheet of lava and limestone in the immediate vicinity. It was that the best British specimens of crystallized pyrolusite were found, of whi have a fine series from the old collection of Edmund Pearse (1788–1856), surg of Tavistock. Rhodonite also apparently occurred, for I have a more re specimen showing the pale pink very fine-grained mineral in grey quartz chert, labelled 'Manganese deposit, no. 2, quartz vein approaching the dep St. Stephens by Launceston'.

Half a mile north of Higher Truscott and directly adjoining Langore ha on the south there are some old completely overgrown manganese workings w an adit-level leading up to them from the stream to the west. There is also in t parish, in a meadow on Athill farm a mile south of Egloskerry (six-inch Ordna map, Cornwall, 16 NW.), an old adit-level now completely blocked and wit dump, which was, however, evidently driven for manganese and where I found traces of pyrolusite.

St. Mary Magdalene, Launceston, Cornwall.

(Six-inch Ordnance map, Cornwall, 16 SE. and 17 SW., 1907.)

The earliest published reference to the occurrence of rhodonite in the Brit Isles is that given by Dr. J. F. Berger in the Transactions of the Geological Socie London, 1811, ser. 1, vol. 1, p. 172, in which he states that the pink silicifer oxide of manganese, the same variety that is found in the mines of Nagyag Transylvania, is worked at St. Mary Magdalene, a mile south of Launcest Berger states that he was informed of this and it is clear that he had not persona visited the locality, the location of which, despite many inquiries, I have so failed to find. It seems very improbable that rhodonite has ever been used a source of manganese in the British Isles.

Greystone Wood manganese mine, Lezant, Cornwall.

(Six-inch Ordnance map, Cornwall, 23 NW., 1907.)

This small mine is situated four miles south-east of Launceston in the pa of Lezant and was worked from 1877 to 1880, when it produced about 150 t of manganese ore (pyrolusite) valued at £150. It was reopened for a short t in 1907 when a little exploratory work was done, but no ore raised. It appe to be a bedded deposit of the usual type, the enclosing rock being Culm Meas chert and slate with intrusions of greenstone in the proximity. The ore is pri pally pyrolusite with some rhodonite. The rhodonite is pale pink and very fi grained, much admixed and veined throughout with quartz and chert, a occasionally includes specks of chalcopyrite. In acid it effervesces strong indicating a good deal of carbonate. Masses of this pale pink rhodonite may s be found, though not abundantly, on the most recent dump at the lower end the wood. In the Geological Survey Memoir (1911), under the output of minera Greystone Wood manganese mine is credited as having produced, in addition manganese ore, a few hundredweights of lead. This galena was, however, fr

neighbouring lead mine of North Wheal Tamar or Greystone silver-lead mine l not from the manganese mine, as reference to the official returns for 1879 l show.

Sydenham and Lee Wood manganese mine, Marystow, Devonshire.

(Six-inch Ordnance map, Devonshire, 87 SW., 1907.)

This small mine was worked under the management of Thomas Small of denham House in 1870–1871, when it produced 117 tons 11 cwts. of manganese in the form of pyrolusite, valued at £375. 13*s*. 6*d*. In 1914 the adit and shaft re cleared with a view to reworking, but nothing further was done. The osit is of the usual bedded type, in Lower Culm chert, there being an intrusion greenstone in the immediate vicinity. Rhodonite is abundant as pink very e-grained masses in dove-grey chert much veined with quartz. Some of the sses when polished are beautiful, their colour a mottled pale pink to purplish aceous with small cinnamon-coloured patches and an outer ring and inroads black pyrolusite. It shows decided effervescence with acid. Minute specks of lybdenite are occasionally embedded in it.

Allerford manganese mine, Marystow, Devonshire.

(Six-inch Ordnance map, Devonshire, 87 SW., 1907.)

This mine, which is not shown on the six-inch Ordnance map, is situated on the ith bank of the stream 540 yards a little south of west of Allerford farm-house. is evidently a bedded deposit in the Lower Culm chert and was worked from e year 1868 to 1873 by Charles, John, and Frederick Sims of Calstock.[1] The ount of ore (pyrolusite) produced is not known, as in every year, with the ception of 1872, when it produced 42 tons valued at £5 a ton, the returns were gregated with the Sims brothers' other mines. The dumps are now completely wn over, but when visited by Mr. Arthur Kingsbury and myself in 1944 we tained a single but interesting mass in which rhodonite is associated with dochrosite. The rhodonite is pale pink and exceedingly fine-grained and is re or less interlaminated with grey or dove-coloured banded chert. Intimately ociated with it is pale pink rhodochrosite of comparatively coarse grain and wing well-defined rhombic cleavages, and in one part of the mass forming a tinct veinlet. This rhodochrosite is completely soluble in dilute acid. Both donite and rhodochrosite include many minute blebs of glassy quartz, while the erior of the mass as usual consists of pyrolusite and a white chalky substance.

Week manganese mine, Milton Abbot, Devonshire.

(Six-inch Ordnance map, Devonshire, 97 NE., 1889.)

Rhodonite was recorded as occurring at this locality by the Lysons in their gna Britannia, vol. 6, Devonshire, 1822, p. 269, and I have a specimen from

[1] The Sims brothers, with headquarters at Slimeford, Calstock, Cornwall, were for many rs (1860 to 1880) actively engaged in manganese mining in east Cornwall and Devonshire. des actually working many of the mines they bought ore from those belonging to others had a manganese grading and distributing yard at Slimeford, the remains of which still t. The ore was brought here by carts after having been hand-picked, and, if water per- ed, washed, at the mines.

there which was in the old collection of Edmund Pearse, surgeon of Tavist
On a visit to Week in 1944, in company with Mr. Arthur Kingsbury, we succe
in locating the old workings, which are not shown by name on the 1907 six-
ordnance map, although the old shafts are shown on the 1889 edition. They
situated in three fields some 730 yards south-east of Week farm-house, wh
the valley bottom to the south there is an adit-level probably communic
with them. Here large blocks of rhodonite coated with pyrolusite weighi
or more pounds may still be found lying loose in the field or built into the
walls, and from these intensely hard masses magnificent specimens may
obtained. The line of old shafts which were sunk in chert belonging to the I
Culm extend in a north-easterly direction, but it is only at the southern end
rhodonite is to be found. At a short distance to the east the chert is overla
the Brent Tor lava. The rhodonite has a beautiful uniform rose-pink colou
is for the most part fine-grained crystalline usually breaking with a some
slaty or bedded structure. When polished it has a decidedly wavy appea
with alternating bands of pale and dark pink. It is often traversed by ban
blue-grey chert or prettily veined with dendritic pyrolusite which enhance
appearance, while here and there it has small included patches of colourless g
quartz in which and bounding which the rhodonite has formed definite cry
up to 4 mm. in length. These, though not isolated, show canoe-shaped clea
faces of *m* (110) and striated faces of *M* ($1\bar{1}0$). The rhodonite from this loca
like that of Treburland, has a tendency to become slightly brown on the sur
after exposure to light; polished surfaces are, however, not affected. The
associated minerals so far observed are minute embedded specks of gal
chalcopyrite, and pyrite.

Doubtful and unsubstantiated localities for rhodonite in Cornwall and Devonshire.

Rhodonite, or minerals assumed to be rhodonite, have been recorded from
following additional localities in Cornwall and Devonshire; in each case, howe
the reported occurrence is either very doubtful or manifestly wrong.

Thomas Hogg writing in 1825 gives, in addition to Creva Wood (Pencreb
three other localities for 'red oxide of manganese' as distinct from his 'silicat
manganese'; these are Indian Queens, Veryan, and Trebartha.[1] The red oxid
manganese of these early writers is an ochre-red oxide of iron (haematite) coat
botryoidal pyrolusite or psilomelane, specimens of which occur in several of
manganese mines near Brent Tor, Devonshire, especially at the Monkstone m
J. H. Collins in his Handbook to the mineralogy of Cornwall and Devon (18
evidently using Hogg as a source of information, repeats the three last local
as doubtful sources of rhodonite.[2]

*Indian Queens or Ruthvoes iron and manganese mine, St. Columb Ma
Cornwall* (six-inch Ordnance map, Cornwall, 40 NE., 1907).—This old min
on a true lode in slate (killas) within the metamorphic aureole of the neighb
ing granite. There is no evidence, however, that any of the few minerals contai

[1] T. Hogg, A manual of mineralogy; in which is shown how much Cornwall contribute
the illustration of the science. First edition, Truro, 1825, p. 88.

[2] J. H. Collins, Handbook to the mineralogy of Cornwall and Devon. 1871, p. 88.

t are the result of metamorphism. It was probably the first manganese mine e worked in Cornwall, for the Rev. William Borlase, writing in 1758, says that ad then been recently discovered.[1] Part of this mine is now (1944) still at k as a source of red ochre for iron-oxide paint, and a good deal of manganese he form of pyrolusite, with a little psilomelane, is still met with in pockets. ve, however, never seen a trace of rhodonite nor does its occurrence seem ly here.

endower, Veryan, Cornwall (six-inch Ordnance map, Cornwall, 65 SE., 1907).— everal spots on Pendower beach the cliff section shows curious but not very inuous beds of earthy black pyrolusite resting on a pebble bed (raised beach) slaty chert above and below and in the immediate vicinity bands of impure stone. We learn from the Rev. S. J. Trist, the vicar of Veryan, who wrote in 3, that about the year 1816 this manganese was actually worked for a year o.[2] I have examined this beach section carefully, but could find no other ganese mineral save pyrolusite.

emollett manganese mine, North Hill, Cornwall (six-inch Ordnance map, nwall, 22 SE., 1907).—Trebartha evidently refers to the old manganese mine ch belonged to Colonel Francis Rodd of Trebartha Hall, a series of specimens yrolusite and psilomelane from which were contributed by him and his son Rev. Edward Rodd to the Philip Rashleigh collection about the year 1800 are described in the MS. catalogue of that collection. This mine I have nitely identified as being that of Tremollett, situated on the road-side between dle and West Tremollett, North Hill. The dump is shown on the six-inch but no name given. In 1874 the mine was again at work under the name of ds Green manganese mine. The adit dump and also a shaft in the field on the osite side of the road are still visible but almost completely grown over. I e found both pyrolusite and psilomelane here in abundance, but no rhodonite. he old collection of minerals formed by Thomas Stewart Traill, M.D. (1781–2), now preserved in the Geology department of Liverpool University, there good specimen of rhodonite, no. 2291, the Traill catalogue entry of which ds 'Silicated oxide of manganese, pink-coloured compact. Rodd's mine, near nceston, Cornwall'. It may be added that Treburland is in the same neighbour-d, but as far as I can ascertain it never belonged to the Rodd family.

Vest Down End manganese mine, Egloskerry, Cornwall (six-inch Ordnance map, nwall, 16 NW., 1907).—According to the Geological Survey rhodonite occurred wad in the neighbourhood of this mine in veins and lenses in Culm Measure olarian chert.[3] A very careful search on the dumps of this mine has failed to stantiate the occurrence.

ewannick Hill, Lewannick, Cornwall (six-inch Ordnance map, Cornwall, SW., 1907).—This also is given as a locality for rhodonite by the Geological vey, the mineral being said to have been found in trial holes on a vein in er Devonian slate overlain by lava.[4] Every local endeavour to find the spot failed, neither has reference to the original MS. six-inch geological map

[1] Rev. W. Borlase, The natural history of Cornwall. 1758, p. 130.
[2] Rev. S. J. Trist, Notes on the limestone rocks in the parish of Veryan. Trans. Roy. Geol. Cornwall, 1818, vol. 1, p. 112.
[3] Mem. Geol. Survey, Special Reports on the Mineral Resources of Great Britain, vol. 1. gsten and manganese ores, 1915, p. 45.
[4] Ibid., p. 45.

afforded any confirmation. Records of this kind, unsupported by specimen the mineral, are, to say the least of it, most unsatisfactory.

St. Cleer, Cornwall (six-inch Ordnance map, Cornwall, 28 SW., 1907).—I Memoirs of the Geological Survey, The Geology of the country around Tavis and Launceston, 1911, p. 77, in the description of the calc-silicate rocks i metamorphic aureole near St. Cleer, mention is made of 'a pink mineral i calcareous layers which has the cleavage of pyroxene and is apparently rhodo and it goes on to say that the same mineral had been met with at other loca near the outer margin of the aureole of metamorphism. Dr. J. Phemister, at request, has most kindly examined the rock specimen and section on which statement was based and reports that the rock contains no manganese, n does the mineral conform with rhodonite in its optical properties.

Chillaton and Hogstor manganese mine, Milton Abbot, Devonshire (six- Ordnance map, Devonshire, 97 NW., 1907).—This mine has been worked s what extensively at intervals between 1858 and 1907, and the aggregate production is greater than that of any other manganese mine either in Cor or Devonshire. The ore is pyrolusite with some psilomelane and rhodochro passing into manganocalcite, and occurs in beds and pockets in Lower C chert with intrusions of greenstone in the vicinity. The Geological Survey stated that 'the larger masses of ore (pyrolusite) contain little kernels of rhodonite'.[1] This I have been unable to substantiate, despite careful search. it seems probable that the rhodochrosite was mistaken for rhodonite. rhodochrosite does form a nucleus to masses of pyrolusite and has a dull brown pink colour with quite coarse cleavage faces.

Black Down, Mary Tavy, Devonshire (six-inch Ordnance map, Devonsh 97 NE., 1907).—William Phillips, in 1819, recorded rhodonite as occurring of a pale rose-red and brownish-black colour with crystals of quartz in its cav and associated with pyrolusite,[2] and there are two old specimens answering to description, labelled Black Down, in the Museum of Practical Geology. locality is vague, there being no manganese workings actually on Black D as far as I can ascertain, and it seems quite probable that Week mine, not distant, was the source.

Upton Pyne manganese mine, Exeter, Devonshire (six-inch Ordnance m Devonshire, 68 SW., 1907).—R. P. Greg and W. G. Lettsom (1858) give this n as a locality for rhodonite.[3] No specimens of the mineral from here are know me, neither have I been able to find any at the old workings.

In conclusion, it may be mentioned that there are four other localities in British Isles at which rhodonite has been found, including one which will be scribed in a future paper. These are: Nant manganese mine, Llanfaelrhys, R Carnarvonshire, where it was found by myself associated with ganophyllite, in 1911; and at the neighbouring Benallt manganese mine, where it lately found by Dr. W. Campbell Smith; at Balvraid, Gleann Beag, Glen Inverness-shire, where it was found by Professor C. E. Tilley in 1937 v

[1] Mem. Geol. Survey, Special Reports on the Mineral Resources of Great Britain, vo Tungsten and manganese ores, 1915, p. 46.

[2] William Phillips, An Elementary Introduction to the knowledge of mineralogy. Se edition, 1819, p. 184.

[3] R. P. Greg and W. G. Lettsom, Manual of the mineralogy of Great Britain and Irel 1858, p. 294.

oxmangite[1] in a garnet-grunerite-schist; and lastly a mineral, possibly rhodonite, ch Sir Charles Lewis Giesecke describes as 'red manganese-ore of a rose-red ur', which he found loose in 1826, near Gartan and Glenties, Co. Donegal.[2]

y thanks are especially due to Dr. J. A. Smythe for his ready and most able help in performing the chemical analyses, and also to Mr. Arthur gsbury for accompanying me to certain of the localities, and to Professor . Tilley for the interest he has shown in the minerals concerned.

1. E. Tilley, Pyroxmangite from Inverness-shire, Scotland. Amer. Min., 1937, vol. 22, 720–727. [M.A. **6**–528.]

Sir C. L. Giesecke, A descriptive catalogue of a new collection of minerals in the Museum e Royal Dublin Society, to which is added an Irish mineralogy. 1832, p. 251.

Bustamite from Treburland manganese mine, Cornwall, and its paragenesis.

(With Plate XV.)

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[Read January 24, 1946.]

Bustamite forms an important constituent of the manganese ores of Treburland mine near Altarnun, Cornwall. The rediscovery of this m locality is due to Sir Arthur Russell, who has already presented an account of rhodonite and tephroite of the mine (Proc. Min. Soc. 1944, p. xix). Since then writer has noted bustamite and bementite from the same locality (ibid. p. xxvi), and it is the purpose of the present paper to discuss the composition paragenesis of this bustamite.

Rhodonite and tephroite form the chief silicate constituents of the manga ores exposed on the dumps adjacent to the old Treburland mine shaft. bustamite-bearing assemblages are not uncommon. The minerals associated bustamite are primarily rhodonite and tephroite, but many of the rocks c variable amounts of clinopyroxene and less commonly spessartine garnet ir grown with bustamite (pl. XV, figs. 2 and 4).

The mineral is rather readily distinguished from rhodonite by its pale fl pink colour and its fibrous character, which is an expression of the better develo cleavages. On exposure, the fresh broken surface of bustamite may lose delicate pale pink tint, gradually changing to a brownish hue. Coarse-gra specimens of bustamite, an inch or more in length, carrying dispersed cl pyroxene and associated with fine rhodonite and coarse-granular tephroite o in some abundance.

In their fibrous character and general physical and optical properties the bu mites show much resemblance to wollastonite, with which the mineral has inc been grouped by a number of investigators. The studies, particularly of Sund and later the evidence of X-ray data, support the view that the bustamites triclinic manganese-wollastonite solid solutions.

The cleavages of the Treburland bustamites can be correlated with th recognized in wollastonite, namely a (100), c (001), v (101), t ($\bar{1}01$), if for venience we retain the old monoclinic orientation of wollastonite. These cleavages can all be identified in the cross-sections of the fibrous crystals. T ning, though not common, corresponds as in wollastonite to (100).

Like the analogous iron-wollastonites,[2] the bustamites can be distinguis by their extinction-angles in sections perpendicular to the zone of cleava α': (100) = 47° is a common value for the Treburland bustamites, thus

[1] N. Sundius, Amer. Min., 1931, vol. 16, pp. 411–429, 488–518. [M.A. 5-143.]

[2] C. E. Tilley, Min. Mag., 1937, vol. 24, pp. 569–572.

ably greater than the value for pure wollastonite, α': (100) = 32°. Sections endicular to the acute bisectrix (α) show γ to the trace of cleavage 29–30°, a strong dispersion of the optic axes $v > r$ is visible. The optic axial angle ways small, though variable: values of 2V 30–35° are common though even r angles have been recorded.

o obtain closer knowledge of the composition of the Treburland bustamite, nineral has been isolated and analysed from a coarse clinopyroxene-bustamite nblage containing only accessory rhodonite and spessartine garnet. The iated pyroxene has also been isolated and analysed. The results of these nalyses have been set down in tables I and II and the analyses computed to cular percentages of $CaSiO_3$, $MnSiO_3$, $FeSiO_3$, and $MgSiO_3$. Both analyses been carried out by Geochemical Laboratories.

TABLE I. Analysis of bustamite, Treburland manganese mine, Cornwall.

	Analysis.	Metal atoms on basis of 6 oxygens.		Mol. %.
SiO_2 ...	46·32	1·966	2·00	$FeSiO_3$ ... 15·35
Al_2O_3 ...	1·02	0·051		$MnSiO_3$ ... 47·70
Fe_2O_3 ...	nil	—	2·01	$MgSiO_3$ ... 2·81
FeO ...	8·63	0·305		$CaSiO_3$ ... 34·14
MnO ...	26·50	0·950		Ca: (Mg,Fe): Mn =
MgO ...	0·88	0·056		34·14: 18·16: 47·70
CaO ...	14·98	0·680		
TiO_2 ...	0·03			
H_2O+ ...	1·05			
H_2O- ...	0·24			
	99·65			

e optical properties of the two analysed minerals are:

	α.	β.	γ.	2V.	Sp. gr.
mite	1·692	1·705	1·707	$2V\alpha$ 35°	3·425
yroxene (Manganhedenbergite)	1·710	1·720	1·736	$2V\gamma$ 60°	3·460

e analysis of table I shows that the bustamite is one of the lime-poor varieties, comparable among existing analysed bustamites with one from Långban

ABLE II. Analysis of manganhedenbergite, Treburland manganese mine, Cornwall.

	Analysis.	Metal atoms on basis of 6 oxygens.		Mol. %.
SiO_2 ...	48·79	1·959	2·00	$FeSiO_3$ ... 20·73
Al_2O_3 ...	1·32	0·063		$MnSiO_3$ ... 16·24
Fe_2O_3 ...	nil	—	2·01	$MgSiO_3$ ... 16·85
FeO ...	12·36	0·412		$CaSiO_3$ ... 46·18
MnO ...	9·53	0·323		Ca: (Mg,Fe): Mn =
MgO ...	5·56	0·335		46·18: 37·58: 16·24
CaO ...	21·35	0·918		
TiO_2 ...	0·09			
H_2O+ ...	0·84			
H_2O- ...	0·24			
	100·08			

discussed by Hey[1] and Sundius. From all previously analysed bustamites (Långban and Franklin Furnace) it differs by its higher FeO content.

The change in optical properties with change in composition of bustamite has been carefully studied by Sundius and it will suffice here if we compare the bustamite with those of Sundius, comparing for convenience the value of the β index of refraction. The values are set down below and incorporated in the

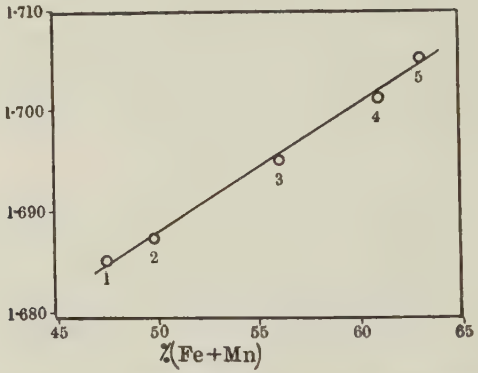


Fig. 1. Variation of refractive index β in the bustamite series, plotted against the sum of Fe+Mn.

graph of fig. 1, showing a rather striking correlation of the β index with the sum of (Fe+Mn).

	β.	(Fe, Mn).
1. $(Mn_{47\cdot5}\ Fe_{0}\ )\ (Ca_{49\cdot2}\ Mg_{3\cdot2})$	1·685	47·5
2. $(Mn_{49\cdot2}\ Fe_{0\cdot6})\ (Ca_{48\cdot6}\ Mg_{1\cdot5})$	1·687	49·8
3. $(Mn_{55\cdot3}\ Fe_{0\cdot8})\ (Ca_{40\cdot2}\ Mg_{3\cdot7})$	1·695	56·1
4. $(Mn_{57\cdot8}\ Fe_{3\cdot2})\ (Ca_{33\cdot1}\ Mg_{5\cdot9})$	1·701	61·0
5. $(Mn_{47\cdot7}\ Fe_{15\cdot3})\ (Ca_{34\cdot1}\ Mg_{2\cdot8})$	1·705	63·0

1–4, Sundius, loc. cit., p. 518. 5. Bustamite, Treburland mine.

The clinopyroxene associated with the bustamite proves to be a manganhedenbergite, not only richer in iron but also in magnesia. The relationship in composition of the pair can be conveniently represented in a triangular plot (CaO : MnO : FeO+MgO) as in fig. 2, where the points of the two analyses are joined by a line. In this plot are also given the composition of analysed manganhedenbergites, schefferites, bustamites, and a number of johannsenites, distinguished as indicated below the figure. The clinopyroxene-bustamite association is a paragenesis of considerable interest.

Bowen, Schairer, and Posnjak[2] have shown that hedenbergite and johannsenite both show inversions to high-temperature forms which are respectively isomeric wollastonite solid solutions and a bustamite. Of these, hedenbergite has the higher inversion temperature at 965° C. The determination of the johannsenite inversion was carried out on an Italian johannsenite described by Schaller,[3] the lower temperature of its inversion being placed at 830° C. The composition of the johannsenite appears to have been close to the ratio CaO : MnO = 1 : 1.

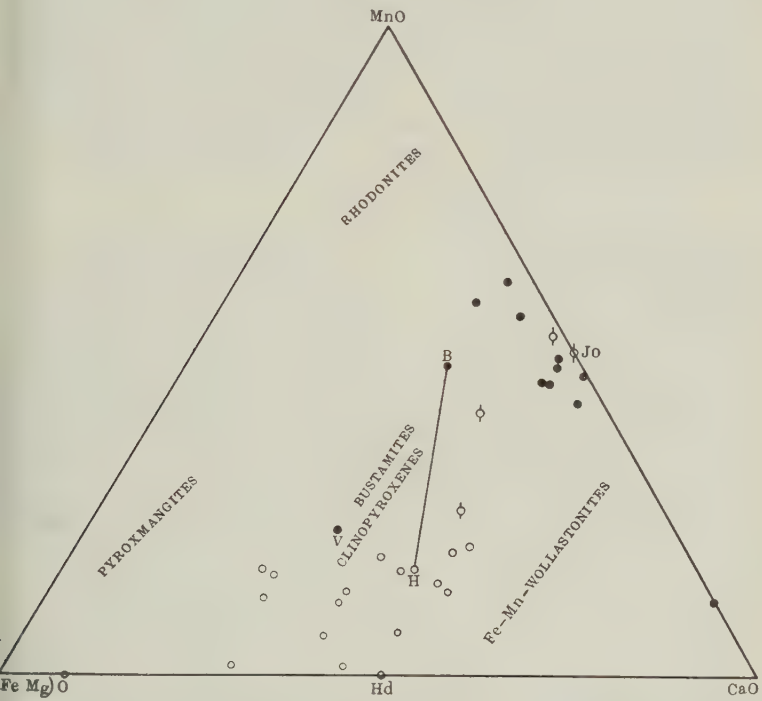
[1] M. H. Hey, Min. Mag., 1929, vol. 22, pp. 193–205.

[2] N. L. Bowen, J. F. Schairer, and E. Posnjak, Amer. Journ. Sci., 1933, ser. 5, vol. pp. 271, 275. [M.A. 5-454.]

[3] W. T. Schaller, Amer. Min., 1939, vol. 23, p. 575. [M.A. 7-222.]

is clear from the plot that the bulk composition of the assemblage of the urland rock, lying on the line BH is within the field both of Fe-Mn-wollasto- solid solutions (bustamites) and of clinopyroxenes (manganhedenbergite- nnsenite solid solutions).

would appear that at the highest temperatures material of this bulk composi- could exist as a single Fe-Mn-wollastonite phase (cf. vogtite in slags), or at r temperatures as a single clinopyroxene phase.



. 2. Plot of the composition (mol. %) of the analysed bustamite (B) and mangan- bergite (H) from Treburland manganese mine, and of allied minerals. Hedenbergites, anhedenbergites, and schefferites—circles; johannsenites—barred circles; wollastonite solutions, including bustamites—dots. V = vogtite.

Treburland the temperature conditions of metamorphism appear to have intermediate—in a temperature region where both phases have crystallized by side.

e existence of bustamite at ordinary temperatures shows that the bustamite nopyroxene inversion may be a sluggish one, and the preservation of iron- ng wollastonites in rocks (Tilley, loc. cit.) points to a similar conclusion as ds the unmixing of the iron analogues.[1] If the association bustamite- pyroxene can be regarded as an equilibrium one at the temperature of its ation we may suppose that the effective metamorphism was accomplished

his observation in an endogeneous contact-zone (Scawt Hill) has now been extended to act skarn carrying iron-wollastonites associated with hedenbergites.

in the solid solution inversion interval which separates an α and β region in sub-solidus of the complex system represented at Treburland (cf. the inver relations obtaining in the simpler artificial system $CaSiO_3$–$FeSiO_3$–β-Ca solid solution–hedenbergite–$FeSiO_3$ solid solution, Bowen *et al.*, loc. p. 213). It is of interest, therefore, to note that the low-temperature phas clinopyroxene, is relatively enriched in (Fe+Mg), i.e. in the hedenbergite diopside components.

The grade of metamorphism of the Treburland assemblages of the sy CaO–MnO–SiO_2–CO_2 is revealed by the co-existing phases of fig. 3 (*a*), e

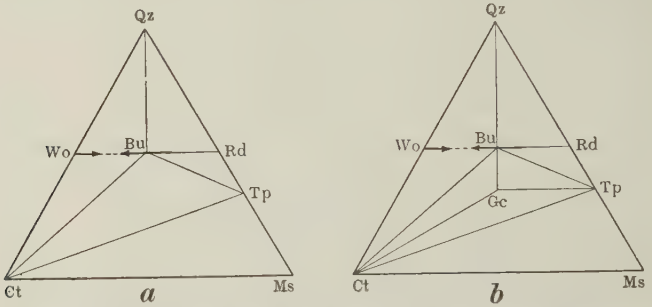


Fig. 3. Assemblages of the system CaO–MnO–SiO_2 in higher grades of metamorphism (Treburland), 3*b* (Franklin Furnace). Qz = quartz, Wo-Bu, wollastonite-bustamite s solutions, Rd = rhodonite, Tp = tephroite, Ms = manganosite, Gc = glaucochroite, C calcite. (Projected from the quaternary system with CO_2 at the apex of the tetrahedron

that we may note that manganosite has so far not been recorded. The bustan assemblages are:

1. Bustamite-rhodonite-tephroite,
2. Bustamite-tephroite-calcite[1] (manganocalcite).

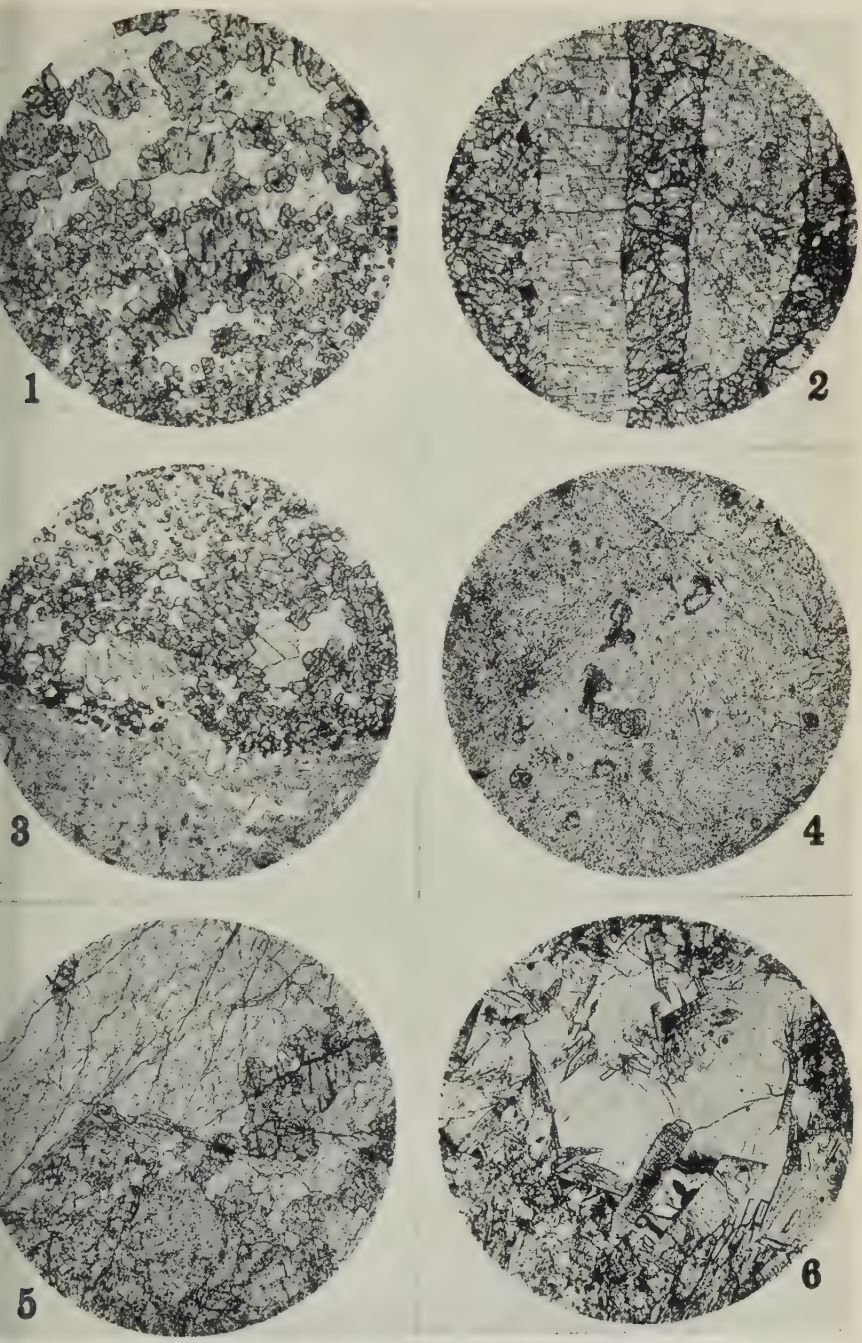
The existence of wollastonite-bustamite solid solutions is indicated by thickened line. The hiatus shown along the Wo–Bu join indicates merely t existing analyses do not wholly cover the wollastonite-bustamite region; ne theless it seems probable that this part of the series is unbroken.

On the rhodonite side it is clear that solid solution is limited, a distinct rhodo phase with its own range of solid solution extending some way towards Bu f the point Rd.

These assemblages are in part depicted in the photomicrographs of pl. The calcite of fig. 1, associated with tephroite, has ω 1·675 corresponding t mol. % of $MnCO_3$ in solid solution, but this is a maximum figure which take account of the probable small content of $FeCO_3$. In fig. 3 calcite, tephroite, bustamite are seen in association, while in fig. 5 coarse bustamite is associa with granular tephroite.

Glaucochroite, the manganese analogue of monticellite, is recorded among manganese silicate assemblages of Franklin Furnace, New Jersey, where i associated, among other minerals, with tephroite. The appearance of glau chroite in the system doubtless corresponds with an advanced, higher temp

[1] The calcite phase is more strictly a solid solution containing small amounts of MnCO



C. E. Tilley: Bustamite, etc., from Treburland mine, Cornwall.

e, stage of metamorphism, one of increasing decarbonation. As fig. 3 (*b*) icates, it can be considered as deriving by a reaction between a bustamite se, tephroite, and calcite, thus:

$$\underset{\text{Bu}}{CaMnSi_2O_6} + \underset{\text{Tp}}{Mn_2SiO_4} + 2\underset{\text{Ct}}{CaCO_3} \rightleftarrows 3\underset{\text{(Gc)}}{CaMnSiO_4} + 2CO_2$$

'he equilibrium assemblages at higher temperatures are then:

Glaucochroite-tephroite-calcite [CO_2],
Glaucochroite-bustamite-calcite [CO_2],
Glaucochroite-tephroite-bustamite [CO_2].

h the incoming of glaucochroite, the high-water mark of metamorphism as ealed thus far in manganese silicate contact-rocks seems to be attained.

n conclusion, the writer desires to express his indebtedness to Sir Arthur sell, who first introduced him to the Treburland metamorphic rocks.

Explanation of Plate XV.

Rocks from Treburland manganese mine, Cornwall.

Magnification 16 diameters.

1. Tephroite-calcite-rock.
2. Bustamite-tephroite-rock with areas rich in clinopyroxene. Two large porphyroblasts of clinopyroxene separated by granular tephroite. Bustamite fringes the clinopyroxene crystal on the left side of the photograph.
3. Junction of tephroite-calcite-rock with granular bustamite-rock. Larger crystal of bustamite surrounded by tephroite and calcite (left centre).
4. Spessartine-bustamite-rock. Isolated crystals of spessartine garnet in fibrous bustamite.
5. Coarse bustamite-tephroite-rock. Above, single crystal of bustamite; below, tephroite, section cut $\perp \gamma$ showing (010) cleavage; centre, wollastonite-like cross-section of bustamite, some calcite.
6. Radiating sheaves of bementite in vein in rhodonite-rock. Idioblastic rhodonites of Pajsberg habit enclosed in bementite.

The structure of kaolinite.

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Physics Laboratories, The University of Leeds.

[Communicated by F. A. Bannister; read January 24, 1946.]

Introduction.

A POSSIBLE structure for kaolinite was first put forward by Pauling (19 in a paper dealing generally with the structures of layer-type mine chlorites, micas, &c. He suggested that the structure consisted of a sheet of Si tetrahedra arranged in a hexagonal network with a superposed sheet of Al–(O,O octahedra, the two together forming a layer of composition $Al_2Si_2O_5(OH)_4$ (fig. Ross and Kerr (1931), from a detailed microscopic study of the kaolin minera concluded that the symmetry of kaolinite is 'probably monoclinic'. The fi attempt at a detailed structure analysis was made by Gruner (1932a) from X-r powder photographs. The reflections, some 40 altogether, were indexed on t basis of a monoclinic cell with a 5·14, b 8·90, c 14·51Å., β 100° 12′. Gruner's wo confirmed Pauling's suggestion regarding the structure of the layer. The valu of the parameters a and b are determined by the dimensions of the Si–O netwo and the ratio of these values, $\sqrt{3}$, follows from the hexagonal arrangement of t Si–O tetrahedra. The height of the cell, $c \sin \beta$, is 14·26Å. and this requires tw $Al_2Si_2O_5(OH)_4$ layers per cell. The space-group finally chosen by Gruner w $C_s^4 = Cc$; the two layers of atoms are related by the glide planes of symmet parallel to (010). Hendricks (1936) obtained additional confirmatory data f Gruner's structure by both X-ray and electron diffraction methods; he agre with Gruner's values for a, b, and c, but gave β 101° 30′. Lists of kaolinite refle tions have also been published by Nagelschmidt (1934) and by Favejee (193 but no further work on the structure of the mineral has been attempted.

We have recently had occasion to examine many kaolinite specimens and in brief note (Brindley and Robinson, 1945) have reported that more reflections a obtained than Gruner recorded and that there are noteworthy differences betwe his and our observations. In particular, we find it impossible to index t reflections with a monoclinic cell. To account for the observed reflections it necessary to postulate a triclinic cell having half the height of Gruner's cell, i containing only one layer of atoms. The reflected intensities are in gene agreement with this structure. We have so far confined our attention to a lay of ideal type, i.e. consisting of regular tetrahedra and octahedra. It is ve questionable whether the structure can be determined in any greater detail fr powder photographs alone, since the majority of the higher-order lines are co posed of several reflections. We believe, however, that the analysis has be carried sufficiently far to show that the structure is essentially triclinic and th the unit cell contains one layer of the type suggested by Pauling.

X-ray powder diagrams of kaolinite.

Powder photographs have been taken with two types of camera: (1) A semi-using camera of diameter 20·05 cm. has been used for spacings greater than 2Å. e material to be examined forms a thin flat powder layer at the centre of the nera and is mounted in a dry state without adhesive. (2) A cylindrical camera he Bradley type of diameter 12 cm. has also been used; specimens of diameters ging 0·3–0·45 mm. were mounted either as dry powders in thin cellophane es or by coating them on fine glass fibres. Cu$K\alpha$ radiation filtered by nickel was employed.

The more outstanding differences between Gruner's observations and our own ur for spacings greater than 2Å. These reflections are also the most useful for ntifying kaolinite in a mixture of minerals. We have therefore examined a iety of kaolinite specimens from widely different localities with the 20 cm. neter camera. The results for spacings greater than 2·1Å. are set out in table I, ch gives also the source of the specimens used and, for materials obtained n the British Museum, their register number. The final column lists Gruner's a. The estimated intensities, which are indicated by the numbers in small e, depend partly on the experimental arrangement, viz. the use of a flat vder layer; if these intensities are to be compared with those for cylindrical cimens (as in table II) allowance must be made for the different absorptions he two cases. It should further be noted that the use of a flat layer tends to roduce a preferential orientation which enhances the basal reflections at 7·13, 7, and 2·37Å.

Kaolinites from the following sources have also been examined, but the results less satisfactory owing to impurities, but in no case do they conflict with the a of table I.

(i) Halle, Province of Saxony (B.M. 14402) with quartz impurity.
(ii) Rainbow Cliff, St. Kitts, British West Indies (B.M. 1924,12,454) with cristobalite and other impurities.
iii) Shore Hill, Otford, Kent (B.M. 1921,119) with quartz and mica.
iv) Ayrshire, Scotland, with quartz and anatase.

The unit cell of kaolinite.

The full list of reflections now obtained for kaolinite is given in table II. These not be indexed on the basis of the monoclinic cell given by Gruner, for not y are some of the spacings different but there are also additional lines. Attempts interpret the data in terms of a monoclinic cell of somewhat different dimen-ns were unsuccessful. The angle β and also the angle α were varied between and 115°. The parameters a and b of Gruner's structure arise from the nensions of the hexagonal network of Si–O tetrahedra and closely similar values found in many layer-type minerals, such as micas and chlorites. If therefore s type of structure exists in kaolinite—and its occurrence in the other kaolin nerals, dickite and nacrite, strongly suggests that it is so—then the a and b rameters cannot differ greatly from those given by Gruner. We have examined iations of a from 5·05 to 5·2Å. and of b from 8·8 to 9·1Å. The height of the is obtained as a multiple of 7·13Å. from the basal reflections which are greatly anced by the use of orientated layers.

TABLE I. X-ray powder data for specimens of kaolinite (spacings greater than 2·1 Å.).

(1).	(2).	(3).	(4).	(5).	(6).	(7).	(8).	(9).	(10).	Gruner's data.
7·134 10	7·15 10	7·15 10	7·14 10	7·16 10	7·15 10	7·16 10	7·15 10	7·16 9	7·15 13	7·13
4·460 4	4·446 7	4·451 6	4·453 4	4·445 6	4·453 6	4·457 6	4·451 5	4·458 6	4·455 5	—
4·354 5	4·354 5	4·352 6	4·344 6	4·352 6	4·343 5	4·357 9	4·347 6	4·346 5	4·339 5	4·39
4·176 5	4·174 6	4·169 7	4·166 5	4·162 4	} 4·145 4	4·170 8	4·168 4	} 4·155 5	} 4·158 3	4·21
4·128 3	—	4·119 2	4·117 3	—		4·120 3	4·119 2			
3·844 4	3·836 3	3·835 2	3·832 4	3·840 1	3·837 2	3·836 4	3·832 3	3·840 2	3·840 2	(4·02)*
3·733 2	3·732 1	3·733 1	3·725 2	3·757 1	3·741 1	3·732 2	3·731 1	3·742 1	3·716 1	3·76
3·567 15	3·568 15	3·567 15	3·561 15	3·567 15	3·564 15	3·566 15	3·564 15	3·569 15	3·570 15	3·57
3·368 3	3·379 2	3·372 1	Quartz	—	Quartz	3·360 3	3·337 1	3·377 1	—	3·35
3·148 1	—	—	3·129 ½	—	—	—	—	—	—	—
3·094 1	—	—	3·088 ½	—	—	—	—	—	—	3·08
2·746 2	—	2·745 ½	2·749 1	—	2·768 ½	—	2·736 ½	—	—	—
2·556 4	2·554 5	2·555 5	2·551 4	2·553 5	2·552 5	2·553 5	2·554 4	2·552 6	2·553 4	2·556
2·529 2	2·515 3	2·523 2	2·520 2	2·520 2	2·517 1	2·521 2	2·521 2	2·520 2	2·520 1	—
2·486 4	2·488 6	2·485 6	2·482 5	2·488 6	2·482 5	2·486 6	2·486 5	2·488 6	2·486 4	2·491
2·376 2	2·372 2	2·378 1	2·371 1	2·375 1	2·373 2	2·374 1	2·375 1	2·375 2	2·373 3	2·373
2·333 6	2·332 9	2·334 10	2·329 7	2·333 11	2·329 8	2·332 11	2·331 9	2·329 10	2·329 7	2·341
2·286 4	2·286 5	2·288 6	Quartz	2·285 5	2·282 5	2·285 7	2·286 4	2·285 6	2·281 4	2·272
2·242 1	2·250 ½	2·250 ½	2·239 1	—	—	2·240 ½	—	2·244 ½	—	—
2·183 2	2·188 1	2·182 ½	2·180 1	—	—	—	2·179 ½	2·182 1	—	2·200
2·127 1										

* This may be the Cu$K\beta$ reflection from 3·57 Å. spacing.

1. A purified Cornish china-clay; a very good kaolinite with a trace of mica; most of our measurements have been made on this material; results in column 1 are average values for eight determinations.
2. Röchlitz, Saxony (B.M. 1911,1113,5); a good kaolinite containing impurity not identified with certainty, but may be analcime.
3. Stahlberg, Pfalz, Rhenish Bavaria (B.M. 60038); very good kaolinite; no impurities observed.
4. Kahan hill, Mergui district, Lower Burma (B.M. 1911,634; excellent kaolinite giving very sharp lines. With appreciable amount of quartz.
5. Ambalangoda, Ceylon (B.M. 1923,1002); kaolinite lines diffuse; with coarse quartz and other impurities not identified.
6. Darling Range, Western Australia (B.M. 66161); kaolinite lines rather broad; trace of coarse quartz and other impurities.
7. Westcott, Dorking, Surrey (B.M. 1908,315); good kaolinite with trace of quartz; specimen pink coloured.
8. Kashinà, Kamyshlov district, Perm, Russia (B.M. 1922,911); with trace of quartz.
9. Cook's Kitchen mine, Redruth, Cornwall (B.M. 19014), var. lithomarge. A clear photograph agreeing with kaolinite, the 4·17···4·12 Å. doublet not resolved.

ailing to find a suitable monoclinic cell, we examined the possibility that the might be triclinic. This seemed not unlikely because of the occurrence of a nber of doublets, particularly at small angles; the closeness of the doublets gested that one angle, either α or β, might be close to 90°. The angle γ between a- and b-axes was kept at 90°. A cell to fit the observed reflections was ntually found with:

a 5·14, b 8·93, c 7·37Å., α 91·8°, β 104·5°–105·0°, γ 90°.

he main difference between this cell and Gruner's, apart from its triclinic ure, is the c parameter which is approximately half of Gruner's value. The eness of the agreement between the observed and the calculated planar ings is shown in table II; the observed values down to 2·1Å. are mean values he ten specimens of table I, and below 2·1Å. are mean values for specimens 1 3 only. The latter were selected for the higher-order measurements because gave the sharpest lines and contained little or no observable impurities.

LE II. Comparison of observed and calculated spacings and reflected intensities for kaolinite.

	$d_{calc.}$	$F^2\phi(\theta)10^{-3}$.		$d_{obs.}$	Observed intensity.
	7·132	488		7·15	vvs*
	4·460	59		4·453	m−
	4·361	172		4·349	m
	4·323	17			
	4·164	181		4·170	m
	4·117	86		4·120	w+
	3·841	141		3·837	wm
	3·729	73		3·734	w
	3·566	265		3·566	vvs*
	3·416	8		—	—
	3·363	85		3·365	wm
	3·142	25		3·138	w
	3·092	37		3·091	w
	2·832	3		—	—
	2·743	34		2·748	w
	2·561	23			
	2·558	22	85	2·553	ms
	2·543	40			
	2·525	46			
	2·515	35	81	2·521	wm
	2·495	57			
	2·485	54	124	2·486	s
	2·478	13			
	2·378	50		2·374	ms*
	2·337	159			
	2·336	164	323	2·331	vs
	2·330	11		—	—
	2·297	24			
	2·284	161	185	2·284	s
	2·244	6			
	2·230	7	13	2·243	vw
	2·220	13			

hkl.	$d_{calc.}$	$F^2\phi(\theta)10^{-3}$.		$d_{obs.}$	Observed intensity.
$2\bar{2}1$	2·217	4			
201	2·193	4			
$1\bar{3}\bar{2}$	2·191	4	20	2·182	w+
$2\bar{2}0$	2·178	12			
220	2·161	1			
$04\bar{1}$	2·150	4			
$02\bar{3}$	2·126	14			
041	2·110	8	22	2·127	w
$22\bar{2}$	2·083	0·0			
023	2·071	0·4			
$2\bar{2}2$	2·059	9·3	9·7	2·057	vw
$20\bar{3}$	1·990	17·8			
$1\bar{3}2$	1·985	30·8	48·6	1·985	ms
$2\bar{2}1$	1·973	2·5			
221	1·945	14·0			
132	1·932	29·5	43·5	1·935	wm
$1\bar{1}3$	1·926	3·5			
$04\bar{2}$	1·920	10·4			
113	1·902	2·8			
$13\bar{3}$	1·893	15·3	18·1	1·892	w
$04\bar{2}$	1·865	8·4		1·865	vw
$13\bar{3}$	1·841	12·6			
202	1·832	11·7	38·3	1·835	wm
$22\bar{3}$	1·831	14·0			
$11\bar{4}$	1·806	7·9			
$22\bar{3}$	1·804	4·2	12·1	1·805	vw
$1\bar{1}\bar{4}$	1·786	0·3			
004	1·783	12·7		1·778	m*
$2\bar{2}2$	1·708	9·4		1·704	vw

↑ sharp very clear background

(00l) reflections for which the observed intensities are enhanced, owing to preferential tation. Observed intensities estimated visually in decreasing order of strength, vvs, vs, s, m, m−, wm, w+, w, w−, vw.

hkl.	$d_{calc.}$	$F^2\phi(\theta)10^{-3}$.		$d_{obs.}$	Observed intensity.
$1\bar{5}0$	1·686	1·0			
$24\bar{1}$	1·684	10·4			
$31\bar{1}$	1·682	3·3	17·5	1·682	w
$3\bar{1}\bar{1}$	1·682	1·8			
222	1·681	1·0			
$24\bar{1}$	1·679	0·5			
150	1·676	7·4			
$15\bar{1}$	1·676	6·8			
$02\bar{4}$	1·675	3·7			
$2\bar{4}0$	1·666	9·8			
$20\bar{4}$	1·663	44·7	108·5	1·659	s
$1\bar{5}\bar{1}$	1·660	9·9			
$1\bar{3}3$	1·659	44·1			
$04\bar{3}$	1·654	6·2			
240	1·654	3·9			
$31\bar{2}$	1·649	3·3			
$3\bar{1}\bar{2}$	1·644	9·2			
024	1·638	4·9			
$3\bar{1}0$	1·631	4·8			
$24\bar{2}$	1·627	0·4			
310	1·627	8·1			
$1\bar{5}1$	1·619	6·4	62·0	1·616	ms
133	1·614	40·0			
$24\bar{2}$	1·604	7·1			
043	1·601	3·8			
151	1·591	0·8			
$15\bar{2}$	1·590	1·1	11·6	1·581	wm
$13\bar{4}$	1·583	10·5			
$2\bar{4}1$	1·574	2·5			
$22\bar{4}$	1·572	1·9			
$1\bar{5}\bar{2}$	1·557	1·4			
241	1·546	2·8			
$22\bar{4}$	1·546	9·2			
$1\bar{1}4$	1·542	0·8	52·2	1·539	m (very broad)
$13\bar{4}$	1·539	15·9			
$31\bar{3}$	1·538	6·2			
203	1·534	17·3			
$3\bar{1}3$	1·531	0·4			
114	1·525	3·8			
$3\bar{1}1$	1·511	4·9			
311	1·505	0·1			
$24\bar{3}$	1·500	4·7			
$1\bar{5}2$	1·491	3·4			
060	1·487	41·5			
$33\bar{1}$	1·484	42·5	125·4	1·486	vs (sharp)
$33\bar{1}$	1·483	41·4			
$24\bar{3}$	1·470	0·3			
$06\bar{1}$	1·466	13·4			
$33\bar{2}$	1·463	13·6	31·8	1·464	w
$2\bar{2}3$	1·462	4·8			
$11\bar{5}$	1·462	0·2			

hkl.	$d_{calc.}$	$F^2\phi(\theta)10^{-3}$.		$d_{obs.}$	Obser intens
$33\bar{2}$	1·455	8·2			
$15\bar{3}$	1·454	4·8			
152	1·453	4·7			
$3\bar{3}0$	1·452	7·8	44·0	1·449	wm(br
061	1·447	4·2			
$11\bar{5}$	1·447	1·8			
223	1·439	8·4			
330	1·439	4·1			
$24\bar{2}$	1·435	1·6			
005	1·427	8·2		1·426	wm*(sha
$04\bar{4}$	1·418	3·2			
$15\bar{3}$	1·412	2·1			
$20\bar{5}$	1·401	6·8			
242	1·400	3·5	16·5	1·400	w
$13\bar{4}$	1·398	6·2			
$31\bar{4}$	1·392	0·0			
$06\bar{2}$	1·390	2·4	4·7	1·387	w
$33\bar{3}$	1·388	2·3			
$31\bar{4}$	1·384	1·2			
$33\bar{3}$	1·373	3·0			
$02\bar{5}$	1·372	0·1			
044	1·372	6·7			
$33\bar{1}$	1·369	2·8	10·5	1·368	w
$31\bar{2}$	1·363	0·0			
134	1·362	0·9			
062	1·357	3·6			
312	1·355	2·8			
331	1·352	3·7			
$24\bar{4}$	1·349	1·6			
$22\bar{5}$	1·348	5·2			
025	1·346	1·1			
$15\bar{3}$	1·339	0·3			
$13\bar{5}$	1·338	34·2		1·335	m (ve
$22\bar{5}$	1·326	0·9			cle
$24\bar{4}$	1·318	0·5			back-
$13\bar{5}$	1·305	28·6			grou
204	1·300	30·0	59·3	1·302	ms(br
153	1·300	0·3			ened li
$15\bar{4}$	1·299	0·4			
$06\bar{3}$	1·291	2·2			
$26\bar{1}$	1·288	6·8	20·5	1·289	w
$26\bar{1}$	1·284	11·5			
$40\bar{1}$	1·280	11·8			
$26\bar{0}$	1·280	7·4			
$24\bar{3}$	1·280	2·3	32·4	1·280	m (sh
$33\bar{4}$	1·280	2·1			
$11\bar{5}$	1·279	1·6			
$40\bar{2}$	1·279	7·2			
260	1·271	7·5			
115	1·268	0·4			

* (00*l*) reflections for which the observed intensities are enhanced, owing to preferen orientation. Observed intensities estimated visually in decreasing order of strength, vvs, s, ms, m, m−, wm, w+, w, w−, vw.

$d_{calc.}$	$F^2\phi(\theta)10^{-3}$.		$d_{obs.}$	Observed intensity.
1·262	20·2			
1·262	1·8	23·8	1·262	w+
1·260	1·8			
1·257	2·1			
1·257	2·0			
1·251	0·0			
1·247	13·4			
1·243	2·6	30·8	1·244	wm
1·243	13·3			
1·242	1·5			
1·239	1·3			
1·239	2·1			
1·239	4·3	15·5	1·233	wm
1·238	4·1			
1·237	3·0			
1·236	0·7			
1·235	0·4			
1·234	2·5			
1·233	2·5			
1·232	0·1			
1·231	0·1			
1·230	2·0			
1·230	2·1			
1·228	2·6			
1·226	0·9			
1·225	3·0			
1·224	0·8			
1·221	2·8			
1·220	4·5	13·3	1·215	vw
1·219	4·6			
1·217	1·4			
1·215	1·5			
1·213	1·2			
1·212	0·1			
1·210	1·8			
1·203	1·2			
1·202	0·1			
1·201	0·9			
1·201	1·3			
1·199	2·3	14·4	1·198	wm
1·197	3·4			
1·196	0·2			
1·195	2·4			
1·195	2·6			
1·194	0·3			
1·192	1·6			
1·191	0·9			
1·188	7·1		1·188	wm*
1·184	0·7			(sharp)
1·182	0·4			
1·181	0·9			
1·180	4·6			
1·174	4·6			

hkl.	$d_{calc.}$	$F^2\phi(\theta)10^{-3}$.		$d_{obs.}$	Observed intensity.
$24\bar{5}$	1·172	1·4			
$35\bar{1}$	1·170	0·1			
$40\bar{4}$	1·169	1·9			
$26\bar{2}$	1·168	1·9			
135	1·168	3·0			
$35\bar{3}$	1·166	1·9	16·3	1·166	w
$22\bar{6}$	1·165	2·5			
$33\bar{5}$	1·162	2·5			
$06\bar{4}$	1·161	2·5			
$17\bar{2}$	1·158	1·8			
$02\bar{6}$	1·158	1·0			
154	1·156	0·5			
$15\bar{5}$	1·155	0·6			
351	1·154	1·5			
$13\bar{6}$	1·151	1·5			
$22\bar{6}$	1·149	4·2			
$33\bar{5}$	1·143	2·2			
262	1·142	0·2			
026	1·139	0·1			
$17\bar{3}$	1·139	0·4			
$42\bar{1}$	1·139	1·0			
$33\bar{3}$	1·139	2·1			
$24\bar{4}$	1·137	0·1			
$42\bar{4}$	1·134	1·9			
421	1·132	1·9			
172	1·132	0·6			
$42\bar{4}$	1·126	0·6			
064	1·124	1·8			
$13\bar{6}$	1·124	0·6			
$26\bar{4}$	1·122	11·3	15·7	1·122	vw
333	1·120	1·7			
205	1·120	0·3			
$15\bar{5}$	1·120	0·0			
080	1·115	0·5			
$35\bar{4}$	1·114	0·9			
$17\bar{3}$	1·112	1·6			
$44\bar{1}$	1·111	0·4			
$44\bar{2}$	1·111	0·2			
$44\bar{1}$	1·109	0·3			
$44\bar{2}$	1·108	0·7			
$08\bar{1}$	1·108	0·4			
244	1·104	0·8			
$31\bar{6}$	1·104	0·8			
$35\bar{2}$	1·099	1·2			
$31\bar{6}$	1·097	0·1			
081	1·097	0·1			
$26\bar{4}$	1·095	9·2			
$35\bar{4}$	1·094	0·0			
$22\bar{5}$	1·094	3·3	21·9	1·092	w+
$11\bar{6}$	1·091	0·3			
402	1·090	9·1			
$44\bar{0}$	1·089	0·3			
$44\bar{3}$	1·087	1·1			

(00*l*) reflections for which the observed intensities are enhanced, owing to preferential itation. Observed intensities estimated visually in decreasing order of strength, vvs, vs, , m, m−, wm, w+, w, w−, vw.

hkl.	$d_{calc.}$	$F^2\phi(\theta)10^{-3}$.		$d_{obs.}$	Observed intensity.
$1\bar{7}3$	1·084	0·8	11·5	1·080	w
$40\bar{5}$	1·084	5·2			
$2\bar{6}3$	1·082	5·2			
116	1·082	0·3			
440	1·081	0·5			
$3\bar{1}4$	1·079	0·5			
$44\bar{3}$	1·079	1·2			
225	1·079	2·4			
$08\bar{2}$	1·075	1·0			
314	1·072	0·1			
$24\bar{6}$	1·068	1·0			
$04\bar{6}$	1·063	0·5			
$4\bar{2}2$	1·063	1·2			
$17\bar{4}$	1·062	0·4			
$1\bar{5}5$	1·060	0·3			
$42\bar{5}$	1·057	0·3			
422	1·055	0·8	10·9	1·055	vw
082	1·055	1·5			
263	1·054	8·2			
173	1·054	0·4			
$11\bar{7}$	1·049	0·9			
$42\bar{5}$	1·049	1·2			
$33\bar{6}$	1·047	3·3	6·7	1·047	w−
$06\bar{5}$	1·047	3·4			
$4\bar{4}1$	1·045	0·6			
$11\bar{7}$	1·042	0·0			
$24\bar{6}$	1·042	0·3			
$44\bar{4}$	1·041	0·1			
$1\bar{3}6$	1·038	2·4	9·3	1·037	w−
$20\bar{7}$	1·038	2·4			
046	1·035	2·9			
441	1·034	1·6			
$17\bar{4}$	1·032	0·0			
$33\bar{6}$	1·031	4·5			

hkl.	$d_{calc.}$	$F^2\phi(\theta)10^{-3}$.		$d_{obs.}$	Obse inten
$44\bar{4}$	1·030	1·4			
155	1·029	0·9			
$15\bar{6}$	1·029	0·9			
$3\bar{3}4$	1·026	4·6			
$51\bar{2}$	1·023	1·6			
$37\bar{1}$	1·023	0·6			
$51\bar{2}$	1·023	0·3			
$08\bar{3}$	1·023	0·2			
$3\bar{7}1$	1·022	1·0			
$28\bar{1}$	1·022	0·3			
$28\bar{1}$	1·021	1·2			
$2\bar{8}0$	1·021	1·1	6·7	1·019	v*
$3\bar{5}3$	1·019	0·8			
007	1·019	1·9			
$37\bar{2}$	1·018	0·3			
136	1·017	2·6			
$5\bar{1}\bar{1}$	1·016	1·7			
$51\bar{1}$	1·016	0·4			
280	1·015	1·6			
$3\bar{7}0$	1·015	0·6			
065	1·013	5·8	15·5	1·011	w
$24\bar{5}$	1·013	0·5			
$28\bar{2}$	1·012	0·9			
$37\bar{2}$	1·010	1·5			
334	1·010	5·9			
$51\bar{3}$	1·010	0·1			
$51\bar{3}$	1·009	0·8			
370	1·006	1·3			
$17\bar{4}$	1·002	0·1			
$28\bar{2}$	1·002	0·1			
403	1·001	0·3			
$02\bar{7}$	1·000	0·6			
$28\bar{1}$	1·000	0·2			

* (00*l*) reflections for which the observed intensities are enhanced, owing to prefere orientation. Observed intensities estimated visually in decreasing order of strength, vvs s, ms, m, m−, wm, w+, w, w−, vw.

The structure of kaolinite.

As regards the detailed crystal structure we have limited our considerat to the question whether a layer structure of the type suggested by Pauling (19 and subsequently found in dickite and nacrite, will explain the observed in sities of the reflections, assuming the lattice to be triclinic with the dimens given above.

A projection of the layer structure on (001), the basal cleavage plane, is sh in fig. 1; the heights of the atoms above the basal plane are indicated in the The oxygen atoms at heights 0 and 2·19Å. are assumed to form regular tetrah about the silicon atoms at height 0·60Å., and the (OH)s and oxygen atom heights 2·19 and 4·31Å. to form regular octahedra about the aluminium at at height 3·25Å. The base of the unit cell can be fitted into this structure in t different ways inclined at 120° to each other in the manner indicated. Since height of the cell is 7·13Å., there is one layer of atoms per cell as compared

layers in Gruner's cell. It remains to find how successive layers of atoms are ked with respect to each other, i.e. to find the direction of the c-axis. For cell base in fig. 1 there are four possible directions of this axis corresponding ne four ways of combining relative displacements of adjacent layers parallel ne a- and b-axes. It would therefore appear that there are $4 \times 3 = 12$ possi-

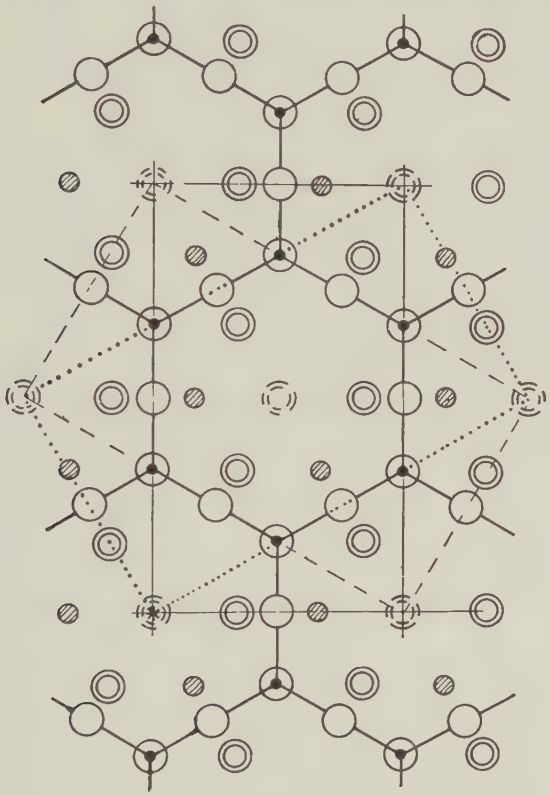

FIG. 1. Projection of the kaolinite layer on (001) showing the three possible bases for the unit cell; the cell adopted is shown in full lines.

ies to be considered, but on determining the atomic co-ordinates we find ally only six different sets of co-ordinates; of these, only one set leads to ulated intensities which are at all closely related to the observed values.

ne outline of the unit cell finally selected is shown by the full lines in fig. 1; rigin of the cell is at the point marked *. The atomic co-ordinates expressed egrees with respect to these axes are given in table III. A projection of the cture on a plane perpendicular to the a-axis is given in fig. 2, which shows also direction of the c-axis relative to the structure.

In calculating the reflected intensities, the f-values of Bragg and West (19 have been used. The third column of table II gives the calculated values of $F^2\phi$ where $\phi(\theta) = (1+\cos^2 2\theta)/\sin^2\theta\cos\theta$ and θ is the Bragg reflection angle. We ag with Gruner in finding no reflections with $(h+k)$ odd, a result which fol directly from the fact that for the ideal layer structure the c-face is cen Although the triclinic axes could be changed to give a cell of half the volum

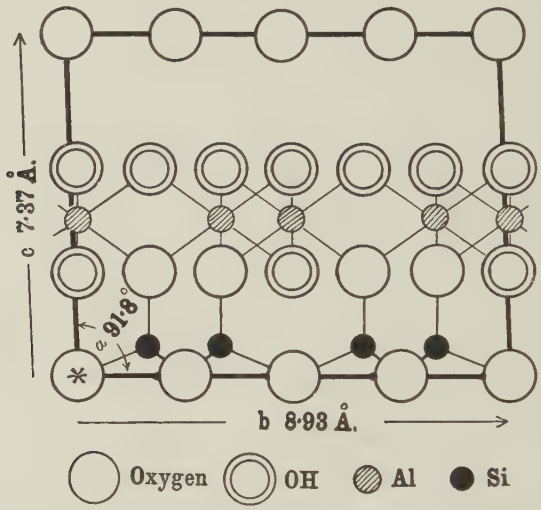

FIG. 2. Projection of the kaolinite structure on a plane perpendicular to the a-axis.

TABLE III. Atomic co-ordinates in degrees for $2Al_2Si_2O_5(OH)_4$. Two equivalent atoms each position arising from centring of the c-face.

Oxygen ...	(0, 180, 0), (90, 90, 0), (90, 270, 0), (39½, 123, 110½), (39½, 243, 110½).
OH	(39½, 3, 110½), (18, 65½, 218), (18, 185½, 218), (18, 305½, 218).
Aluminium	(119, 184, 164), (119, 304, 164).
Silicon ...	(11, 121, 30½), (11, 241, 30½).

seems better to retain the a- and b-axes at right angles and parallel to the ort hexagonal axes of the layer itself, for this brings out the pseudo-monoclinic sh of the cell. In presenting the results, no allowance has been made for absorpt of the radiation in the specimen, which has the effect of diminishing the low order reflections as compared with the higher orders. The observed intensi given in table II are estimated visually from photographs taken with the pow coated on thin glass fibres.

The measure of the agreement found between the observed and calcula intensities indicates that the layer type of structure suggested by Pauling, co bined with the triclinic axes, is essentially correct. The fact that the obser intensities depend to some extent on the preferential orientation of the cr tallites renders a precise comparison with the calculated values rather diffic Specimens formed by coating thin glass fibres show enhancement of (0 reflections, while specimens prepared by packing the powder into celloph tubes give increased intensities from planes making angles approaching with (00l).

nong the lower order reflections the following may be specially noted. The close doublet $(11\bar{1})$ and $(1\bar{1}\bar{1})$ at d 4·170 and 4·120Å. is found with all nites giving sufficiently sharp reflections, and their relative intensities agree with the calculated ratio. The absence of the $(1\bar{1}1)$ reflection is particularly worthy, because out of the six possible orientations of the triclinic axes dis-ed above, only two indicate a negligible intensity for this reflection, and one ese gives hopelessly incorrect values for many other reflections. There is fore no ambiguity as to which of the six orientations to choose. The (111) tion at d 3·365Å. has an observed intensity in good agreement with the lated value. That kaolinite gives a reflection with this d value is important ineralogical analysis because it may easily be mistaken for the strongest z line at d 3·336Å. The doublet $(1\bar{1}0)$ and (110) is too close to be separated our largest camera, but $(1\bar{1}0)$ is very much stronger than (110) and the ved value lies much nearer the stronger line. The doublets $(02\bar{1})$, (021), $(11\bar{2})$, $(1\bar{1}\bar{2})$ show satisfactory agreement between observed and calculated sities, and the very weak line $(0\bar{2}2)$ has not been observed. Among lower-order reflections the (020) alone is somewhat unsatisfactory, for bserved intensity is distinctly greater than the $F^2\phi(\theta)$ value would lead o expect.

r the higher-order reflections it is unnecessary to discuss in detail the data set n table II, but it may be remarked that the calculated values explain, for the part, not only the observed intensities but also the widths of the observed posite reflections. For example, the broad lines at d 1·539, 1·449, and 1·302Å. een to arise from a combination of reflections spread over a range of angles. hermore, between the lines at d 1·778 and 1·682Å., and again between 35 and 1·302Å., we find particularly clear stretches of background which are greement with the calculations.

Discussion.

has been shown by Hendricks (1939) that in dickite and nacrite there is a netrical relationship between the oxygen atoms in the base of one layer and OH)s in the adjacent layer; the relative displacement of successive layers is that each (OH) ion is at the same distance, 2·91Å. (Gruner 1932b, p. 403), its nearest O neighbour in the next layer. In Gruner's structure for kaolinite, thirds of the (OH)–O distances are 2·9Å. and one-third are 2·82Å. In the nt structure for kaolinite we find a similar result, namely, two-thirds of the –O distances are 2·99Å. and the remaining third 2·87Å. Our distances are tly greater than Gruner's owing to a small difference in our c-co-ordinates. mparison of our diagram in fig. 3, with the corresponding diagram for Gruner's ture (see Hendricks, 1939, p. 517), shows that the shorter (OH)–O distance s between different pairs of atoms in the two cases.

e shape of the triclinic cell suggests a closer relation to monoclinic symmetry is really the case, for even if the angle α were 90° instead of 91·8°, a single structure on the base chosen would not have monoclinic symmetry owing e arrangement of the aluminium atoms. Gruner showed that a single-layer ture with monoclinic symmetry could only be based on the cell with the d outline in fig. 1, corresponding to the space-group $C_s^3 = Cm$. A structure monoclinic symmetry on the base that we have chosen would require two

layers per cell with the space-group $C_s^4 = Cc$; this in fact was Gruner's sol of the problem. The absence of monoclinic symmetry for a single-layer stru on this base perhaps indicates why the actual cell is found to be triclinic.

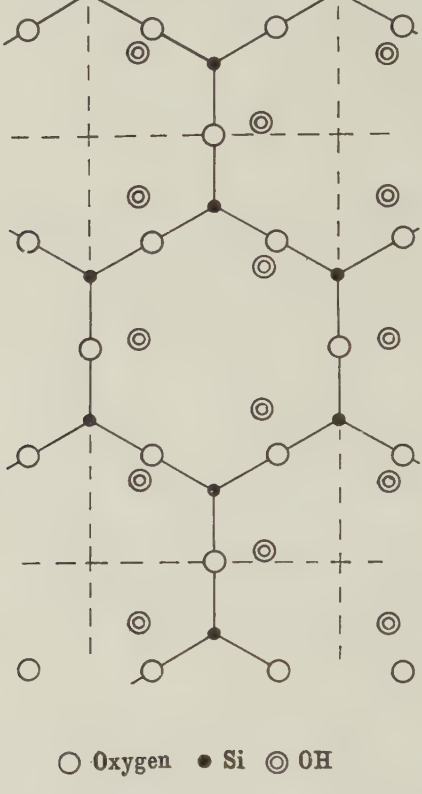

Fig. 3. Projection of adjacent oxygen and (OH) atoms on (001).

Acknowledgements.—Finally, we wish to record our thanks to Mr. F Bannister of the Mineral Department, British Museum, for placing at ou posal specimens of kaolinite from many different localities and also to Dr. Roberts of the Fuel Department of this University, who supplied a numb specimens. We are also indebted to the Department of Scientific and Indu Research for a grant to one (G.W.B.) of us.

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The atomic structure of fluor-apatite and its relation to th of tooth and bone material.

(With Plates XVI—XVIII.)

By C. A. Beevers, D.Sc., F.Inst.P., F.R.S.E., and D. B. McIntyre, B.S
Dewar Crystallographic Laboratory, University of Edinburgh.

[Read June 7, 1945.]

IT is well established by X-ray crystal analysis that the mineral constitu bone and of the enamel and dentine of teeth is essentially hydroxy-a $Ca_5OH(PO_4)_3$, and that hydroxy-apatite has a structure differing only in details from that of the well-crystallized mineral fluor-apatite $Ca_5F(PO_4)_3$. main difference, and in fact the only fully established one, between the two st tures is that the hydroxy-apatite has a slightly larger unit cell than that of fluor-apatite. The structure of the latter has been determined by Náray-Sza and by Mehmel[2] who finally agrees with Náray-Szabó. We have made wh probably a more accurate determination of the structure, using more exten X-ray data. We find that the biggest change required in the atomic co-ordin given by Náray-Szabó is a small alteration in the phosphorus position. and other changes from Náray-Szabó's structure are only of significance w accurate values of interatomic distances are required, and no changes are n in the general arrangement of the bonding.

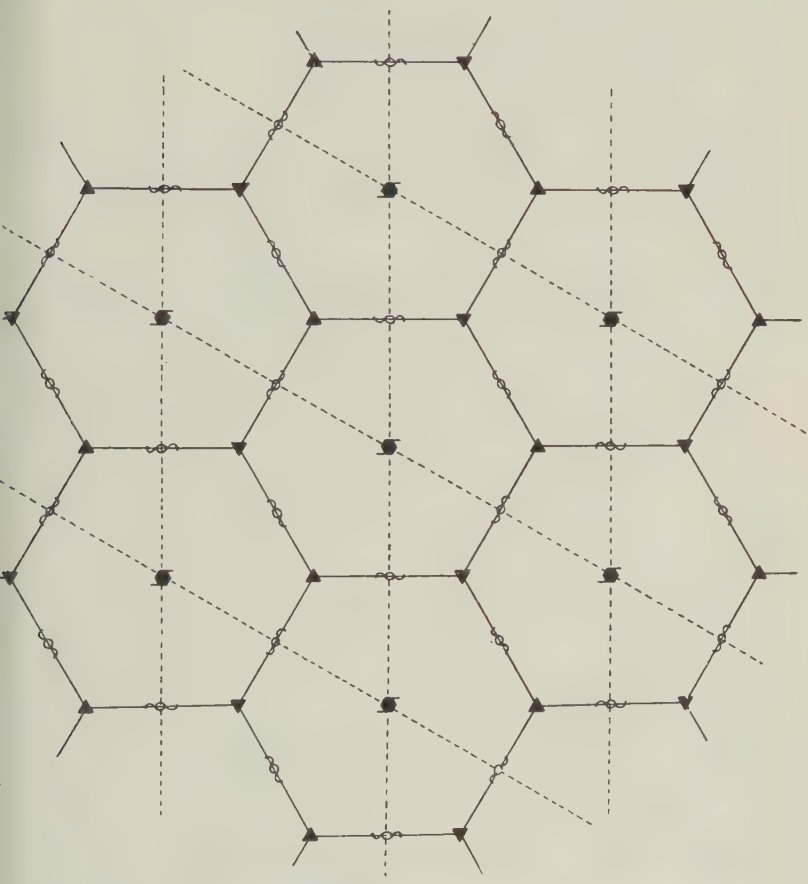
The structure is of considerable importance for the understanding of properties of bone and tooth, and it is thought that the following descriptio it will be of interest and value. Previous accounts of the structure have b inadequate even to those well versed in the understanding of complex structu

The unit cell of the apatite structure has two equal edges inclined at 120 one another. These edges are of length a 9·37Å. in the case of fluor-apatite a 9·41Å. in the case of hydroxy-apatite. The third edge is at right angles to t and has a length of 6·88Å. in both fluor- and hydroxy-apatites. In fig. 1 dotted lines show the a-axes of the cell. The cell possesses vertical symm axes of three kinds: (1) passing through the corners of the dotted unit cell hexagonal screw-axes, these being equivalent to a three-fold rotation axis a two-fold screw axis superposed; (2) passing through the points (2/3, 1/3) (1/3, 2/3) of the cell are three-fold rotation axes; and (3) passing through the way points of the cell edges and through the centre are two-fold screw a There are also centres of symmetry, and mirror planes parallel to the plane of paper: these symmetry elements are not represented in fig. 1.

This arrangement of symmetries means that there are three-fold axes a corners of a sheet of linked hexagons, as shown by the full lines of fig. 1. The fold screw axes are at the centres of the edges of the hexagons, and the six-

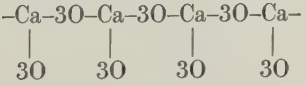
[1] S. Náray-Szabó, Zeits. Krist., 1930, vol. 75, p. 387. [M.A. 4–462.]
[2] M. Mehmel, Zeits. Krist., 1930, vol. 75, p. 323, and Zeits. Physikal. Chem., A, 1931, 15, p. 223. [M.A. 4–462.]

w axes are at the centres of the hexagons. This way of describing the pattern symmetries permits the full structural arrangement to be more easily erstood.



. 1. The arrangement of the vertical symmetry-axes in the apatite structure. The dotted lines show the hexagonal a-axes of reference. Scale, 1Å. = 0·36 cm.

e may now describe the actual arrangement of atoms around these elements mmetry. Along each of the three-fold axes is a chain of Ca atoms one-half e c-axis apart. Each of these Ca atoms is bonded to its neighbours above and w by means of three shared oxygen atoms, thus forming a continuous chain -3O–Ca–3O–Ca–. A chain of this type is shown in fig. 2. Each Ca, however, les being linked to six shared oxygens in this way is also bonded to three gens almost at the same c-level as itself, so that the arrangement may be esented thus:



This means that each Ca atom in such a chain is surrounded by 9 oxygens, b owing to the sharing of oxygens the Ca : O ratio in the chains is 1 : 6. Sim chains of Ca and O also occur in the crystal of $CaCl_2.6H_2O$ (the oxygens here be from the water molecules) and fig. 2 is taken from this structure as determined Jensen.[1] The dimensions of the columns are slightly different in the calcium chlor and apatite structures, however. Also in $CaCl_2.6H_2O$ the columns are rather ma symmetrical, and viewed down the *c*-axis the oxygen atoms around successive atoms fall on top of one another. In apatite there is not t identical repeat of the oxygen arrangement around succes Ca atoms, but only a repeat about every alternate Ca. Th the shared sets of three oxygens fall into two differe groups which do not fall quite on top of one anoth when viewed down the *c*-axis (see fig. 4, pl. XV Furthermore, the oxygens which are linked to only one although accurately on top of one another when viewe down the *c*-axis, are alternately raised and lowered para to the *c*-axis, so that these groups approach one anoth in pairs. The approach enables the pairs to be at the sa time members of PO_4 groups as shown in fig. 3, pl. X each PO_4 group having three oxygens shared by one Ca column, one oxygen projecting outwards from the colum In fig. 4, pl. XVII, projections down the *c*-axis of t arrangement are seen. In this diagram two of the oxyge of each PO_4 group fall on top of one another. Rememb ing this, it is easy to pick out in fig. 4 the three PO_4 grou which are closely linked to a Ca–O column at a giv level. The oxygens projecting outwards from the P groups fitting round one Ca–O column are shared by neig bouring Ca–O columns as shown in figs. 3 and 4, ea neighbouring column being related to the first by a scr axis midway between them. The neighbouring colum therefore, also possess projecting O atoms which are shar by the first column. Thus adjacent columns are link together by two bonds per *c*-axis translation. This li age of the Ca–O columns by the PO_4 groups produces a hexagonal netwo like a honeycomb with channels extending right through the structure in t *c*-direction, as shown in fig. 4, pl. XVII.

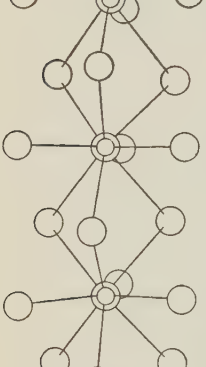


FIG. 2. The calcium–water column from the calcium chloride hexahydrate structure, and similar to the calcium–oxygen columns in apatite. (After A. T. Jensen, 1940.)

Down the centres of the open channels of fig. 4 pass the symmetry eleme 6_3, each equivalent to a three-fold axis plus a two-fold screw axis. The w of these channels are lined with oxygen atoms, the arrangement being s that in the wall of each channel there are six 'caves' per unit length. I these caves calcium atoms will just fit, one Ca going about half-way i each. Thus about half the area of each Ca is left exposed on the inside of channels and the F atoms just fit between the group of three Ca's at one le This lining of the channels by Ca and F atoms is shown in fig. 5, pl. XV where the two F atoms (shown in green) superimpose on each other and

[1] A. T. Jensen, Kgl. Danske Vidensk. Selskab, Math.-fys. Medd., 1940, vol. 17, no

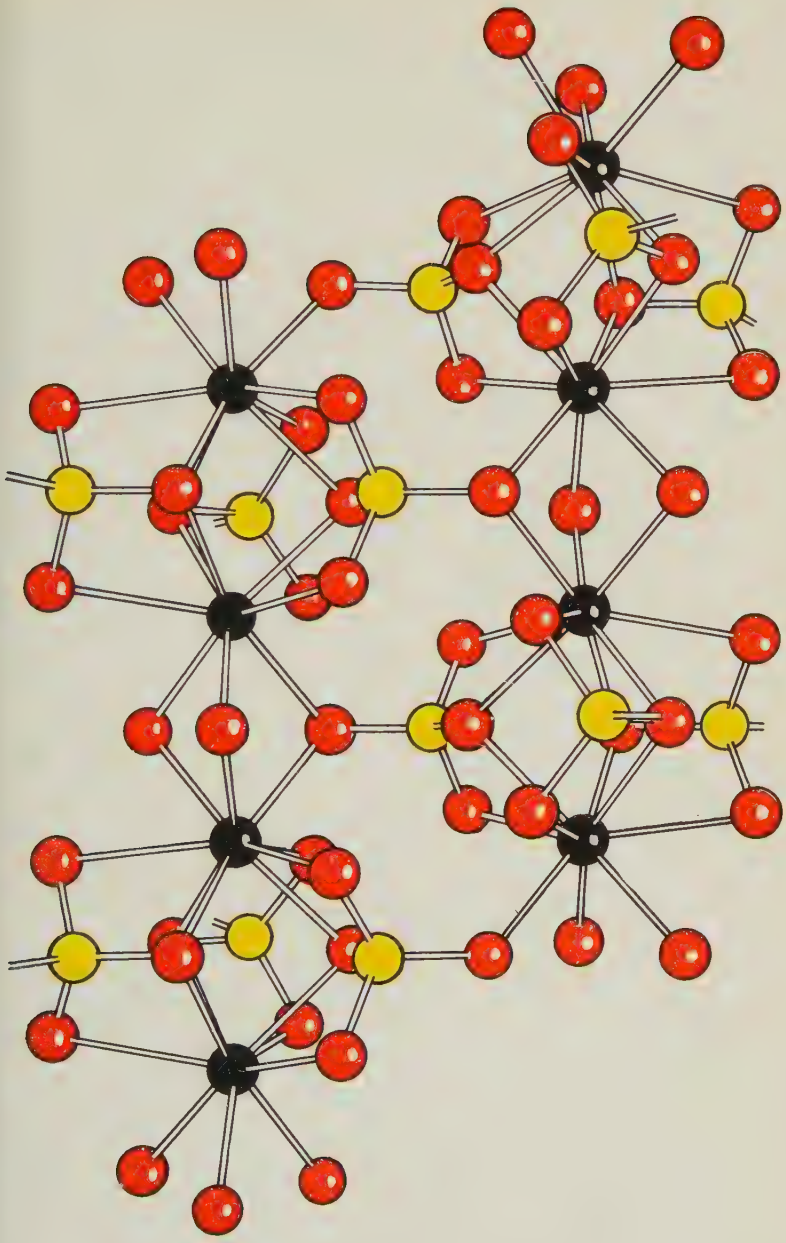


Fig. 3.

C. A. Beevers and D. B. McIntyre: Atomic Structure of Fluor-apatite.

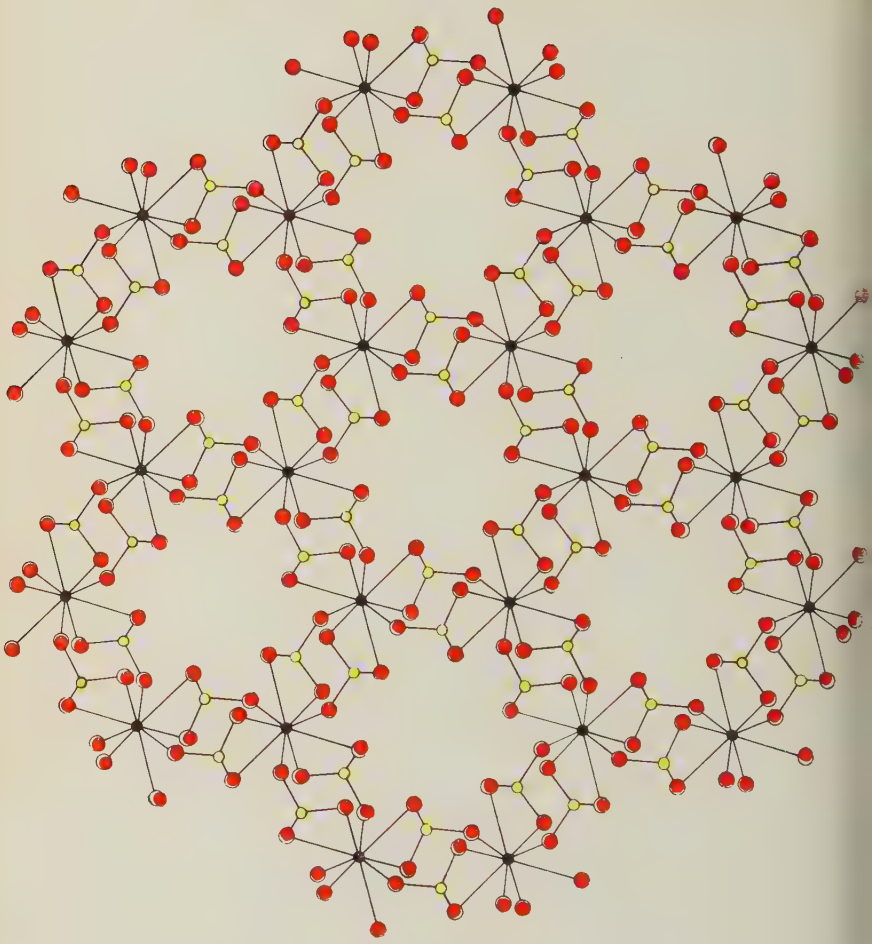
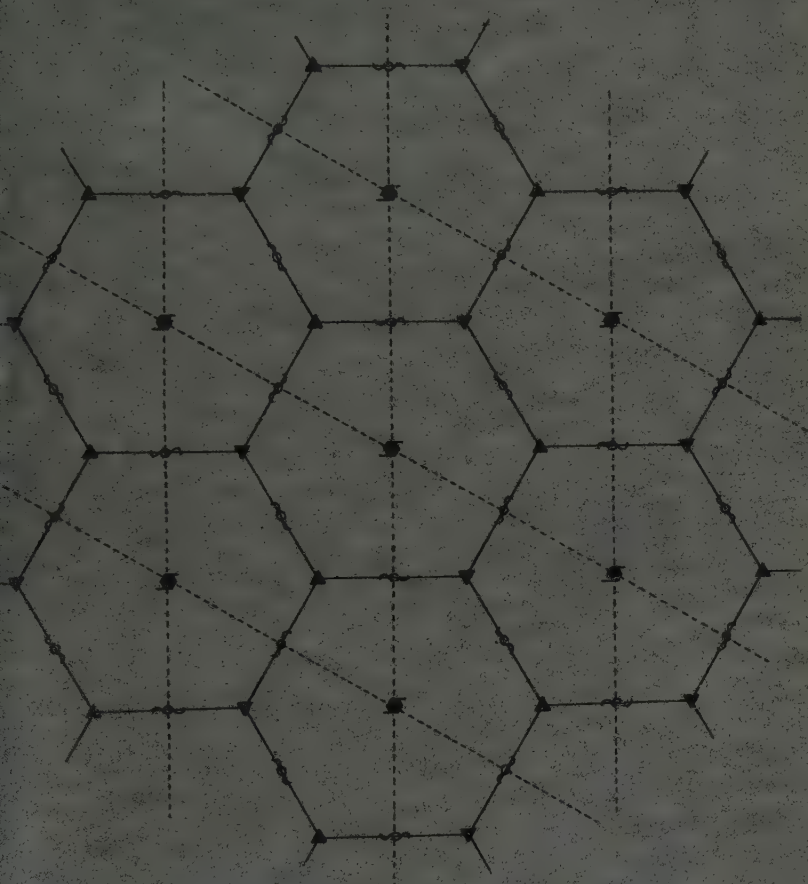


FIG. 4.

C. A. BEEVERS AND D. B. MCINTYRE: ATOMIC STRUCTURE OF FLUOR-APATITE.



C. A. Beevers and D. B. McIntyre: Atomic Structure of Fluor-apatite.
1, overlay for Plates XVII and XVIII, *Mineralogical Magazine*, 1946, vol. 27.

C. A. Beevers and D. B. McIntyre: Atomic Structure of Fluor-apatite
1, overlay for Plates XVII and XVIII, Mineralogical Magazine, 1946, vol. 27

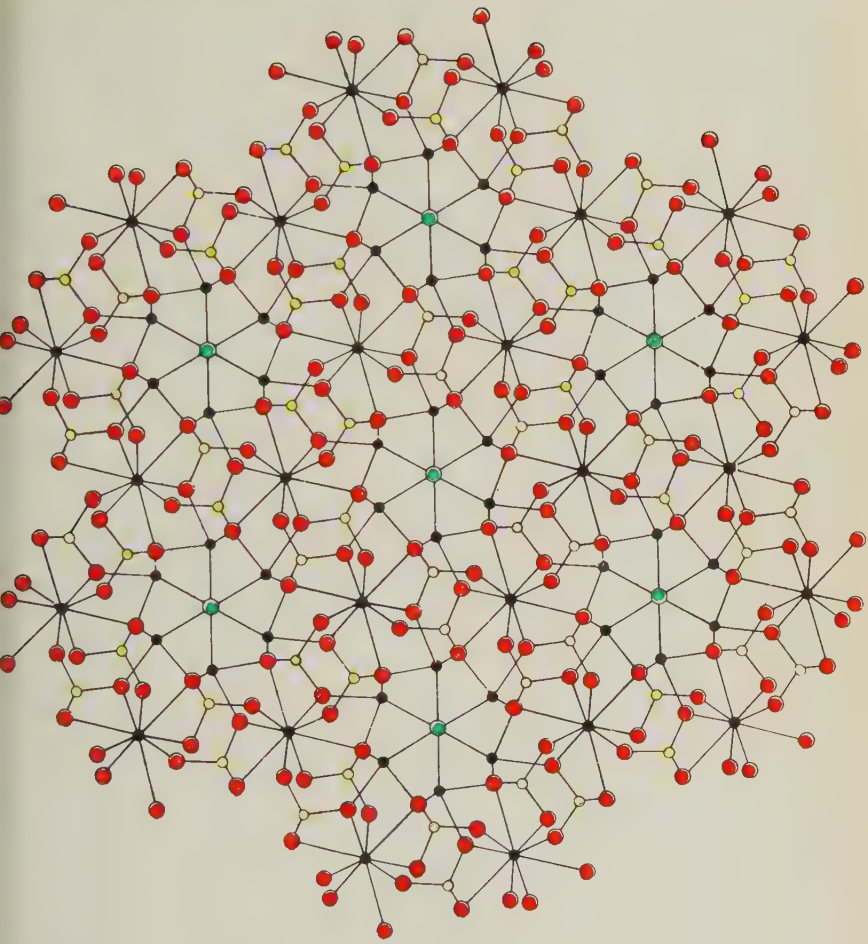


FIG. 5.

C. A. BEEVERS AND D. B. MCINTYRE: ATOMIC STRUCTURE OF FLUOR-APATITE.

). sets of three bonds at different levels form a six-fold arrangement in projection.

This way of regarding the structure brings out some of its important features. e of these is that the size of the hexagonal channels shown in fig. 4 will be inly determined by the calcium and phosphate arrangement, which is likely ɔe a strong and stable one. Another feature is the remarkable planar arrangent of three Ca atoms around each F in fluor-apatite or OH in hydroxy-apatite. ɔm these two features one would expect that the structure would be very ɛctive in its choice of ions to occupy the position of the F ions in fluor-apatite. ɔ only ions definitely known to occupy these positions are the ions F^{-1} and $[^{-1}$, and these two are, of course, very nearly the same size. Each has two K l eight L electrons, but F^{-1} has one nucleus with charge $+9$, whilst OH^{-1} ɛsesses two nuclear charges $+8$ and $+1$ respectively. This has the effect of king OH^{-1} just a little larger than F^{-1}, and the hydroxy-apatite structure is ɛrefore a little expanded compared with the fluor-apatite one.

The very critical fit of the F or OH ion is evidently responsible for the marked ference in the stability of the two apatites. That the fluor-apatite is the more ble is shown by the well-known facts that fossil bone becomes gradually nsformed from hydroxy-apatite to fluor-apatite, and that bone will take up orine selectively even from media very dilute in fluorine.

The remarkable sensitivity of the macroscopic structure of teeth to fluorine, d the relation between the incidence of dental caries and fluorine content are ıer matters of great practical importance. That the structure should also be ısitive to fluorine points to the close relationship which must exist between ɔmic structure and other properties.

Explanation of Plates XVI–XVIII.

The atomic structure of fluor-apatite and its relation to that of tooth and bone material.

ɛs. 1 and 2 in the text; fig. 1 also on a loose sheet of transparent paper as an overlay for showing the symmetry relations of figs. 4 and 5 with rotations about three kinds of axes. In figs. 3–5, calcium atoms (black), phosphorus (yellow), fluorine (green), oxygen (red).

ɛ. 3, pl. XVI. Two calcium–oxygen columns joined by the sharing of oxygens of PO_4 groups.

. 4, pl. XVII. Plan of the complete arrangement of calcium–oxygen columns linked by PO_4 groups in apatite. $\times 36{,}000{,}000$.

. 5, pl. XVIII. Plan of the complete structure, the empty channels of fig. 4 being occupied by additional calcium and fluorine atoms. $\times 36{,}000{,}000$.

The cost of the coloured plates has been met jointly by the Miers Memorial Fund and Carnegie Trust for the Scottish Universities.

The rapid separation and determination of barium, strontium and calcium in rocks and minerals.

By G. H. Osborn, A.R.I.C.

[Read March 28, 1946.]

CALCIUM is one of the most widespread and abundant of metals, coming on the list of elements and third among the oxides of the outer lithosphere it is an essential constituent of a great many rock-forming minerals and therefore, almost always present in rocks. Barium and strontium come much lower in the list of abundance of elements, but nevertheless barium is extremely widespread and occurs in most rocks, igneous, metamorphic and sedimentary,[1] while strontium is also very widespread. It has been stated[2] the average content in igneous rocks of both of these elements is of the order of 0·05 %.

For many years the determination of barium, calcium, and strontium in rocks has followed well-established lines, i.e. fusion of the powdered material with sodium carbonate followed by leaching in acid, dehydration, and filtration to remove the silica. The R_2O_3 group and any manganese are removed by adding an excess of ammonia and bromine water, boiling, and filtering; in the filtrate calcium, barium, and strontium are co-precipitated as oxalates and burnt to the oxides. BaO and SrO are frequently included in the CaO result, since they occur in small amounts comparatively and the separation can only be accomplished by the difference in the solubilities of the nitrates in a mixture of absolute ether and alcohol;[3] this separation is not very good and must be repeated for accurate work.[4] It has also been stated that the strontium result is often low as much as 18 %, due to incomplete precipitation as oxalate (Groves, loc. cit., p. 193). BaO is usually determined nowadays on a separate portion by attacking the powdered mineral with a mixture of sulphuric and hydrofluoric acids followed by evaporation to dryness and the filtration and ignition of $BaSO_4$. This is then fused with Na_2CO_3 and leached with hot water and filtered; the residue is dissolved in dilute hydrochloric acid and a few drops of sulphuric acid added to precipitate the barium as sulphate. It must be purified from calcium by treating in a platinum crucible with concentrated sulphuric acid and heating to dissolve, when it is poured into cold water and allowed to stand overnight; under these conditions the calcium sulphate remains soluble (Groves, loc. cit., p. 138). It will thus be seen that even the determination of lime content is very lengthy, whilst the additional call for strontia or baria necessitates great time, skill, and patience.

[1] A. W. Groves, Silicate analysis. London, 1937, p. 193. [M.A. **6**–483.]

[2] W. Noll, Chemie der Erde, 1934, vol. 8, pp. 507–600. [M.A. **6**–87.] W. von Engelhardt, Chemie der Erde, 1936, vol. 10, pp. 187–246. [M.A. **6**–296.]

[3] H. Rose, Pogg. Ann., 1860, vol. 110, p. 292. W. Noll, Zeits. Anorg. Chem., 1931, vol. 199, pp. 193–208. [M.A. **5**–142.]

[4] F. P. Treadwell and W. T. Hall, Analytical chemistry. 9th edit., 1942, vol. 2, p. 25.

During some work on the distillation of fluorine in fluorspar by the Willard-inter method it was noticed by the author that the sulphates of calcium and rium, both known to be present, were entirely soluble in boiling perchloric acid; is led to an investigation of the solubilities of calcium, barium, and strontium lphates in which it was found that whilst calcium sulphate was entirely soluble perchloric acid, both barium and strontium sulphates could be rendered soluble, thus providing an easy method of separation from calcium. The results this investigation were communicated to the Society of Public Analysts.[1] Sub-quently the idea of applying this method to rocks to simplify the present tedious ethods was formed and it was decided to carry out an investigation. As the ethod called for the use of perchloric acid it seemed obvious to try to decompose e rock by a perchloric-hydrofluoric acid mixture which would not only be uch more speedy than the alkali attack but also cut out the risk of impurities the reagents; in addition this attack would not have the disadvantage of soluble sulphates formed in the sulphuric-hydrofluoric attack. This idea was t new: H. F. Harwood (in Groves, loc. cit., p. 137) has suggested it in a direct thod for lime, but Groves (loc. cit., p. 137) found that if much lime was present ere was some difficulty in decomposing the specimen completely and recom-ended the method chiefly for felspars. In view of this it was thought best to rry out some preliminary experiments on this method of attack, and it was und that, provided the material was sufficiently finely ground, all the rocks ied were completely attacked.

Dr. Groves kindly provided a rock sample with a lime content of 15% and this hen ground to 200 mesh was entirely decomposed by the acid attack; to this ecimen were added 10% additions of very refractory minerals such as ilmenite, urmaline, and garnet, and in all cases, provided the powdering had been well rried out, complete attack was found, and the author, therefore, has no hesita-on in recommending this method of attack.

After these conclusions had been reached it was reported from America[2] that orkers there using the perchloric-hydrofluoric attack had found complete attack uring their experiments and no difficulties or doubts were expressed. It was und, however, that for most rocks it was necessary to increase considerably the mount of perchloric acid and hydrofluoric acid recommended by Harwood, and is is confirmed by the American workers who more than doubled the amount. he amounts found by the author to give quick and complete attack are given low and it will be seen that these are threefold the amount recommended by arwood, but on the other hand it has never been found necessary with this ncentration to evaporate seven or eight times for a rock containing as little as % lime.

Separation and estimation of barium.

When considering the application of the method of separation of barium and lcium sulphate in perchloric acid to rocks, it was thought that, after the rock d been completely attacked by the perchloric-hydrofluoric acid scheme and e silica volatilized, the mere dilution with hot water and the addition of 1 ml. of lphuric acid would be sufficient to throw out the barium as sulphate without any

[1] G. H. Osborn, Analyst, 1945, vol. 70, pp. 207–210.

[2] G. G. Marvin & L. B. Woolaver, Ind. & Eng. Chem. (Anal. Edit.), 1945, vol. 17, . 554–556.

interference due to calcium; whilst if no barium were present there would be precipitate and the absence would be seen at a glance. In point of fact the deductions proved to work very well as will be seen from the following experiments.

Experiment 1.—One gram of powdered rock[1] (< 200 mesh) containing 15 lime was weighed into a platinum crucible together with 0·1 gram $BaSO_4$ a attacked with 10 ml. $HClO_4$ and allowed to evaporate to about 5–6 ml.; th 20 ml. of HF was added and the whole evaporated to low bulk after the addi of a further 10 ml. of $HClO_4$. When nearly taken to dryness yet a further 10 r of perchloric acid was added and the solution finally evaporated until salts be to crystallize. The whole was then washed into a beaker and diluted to al 150 ml. with boiling water. The solution was turbid owing to the immedi precipitation of $BaSO_4$ and 5 ml. of 1/1 sulphuric acid was added; the solu was boiled and filtered on a no. 42 Whatman, washed free of acid, burnt off, weighed as $BaSO_4$. The amount recovered was 0·0999 gram. The experiment repeated exactly with the same rock powder but without the addition of bar sulphate; this time on dilution the solution remained crystal clear and the addi of sulphuric acid was without effect. It will thus be seen that the detection a estimation of barium in rocks will appear to have been much simplified, wh its total removal makes the estimation of the calcium present much simpler a later stage.

The estimation of calcium as the oxalate in acetic acid.

When considering the whole problem of the estimation of calcium in rocks a minerals, it appeared to the author that if calcium could be precipitated in acet acid there would be no necessity to precipitate the R_2O_3 group, and the tedio necessity of reprecipitating before the calcium could be estimated would l entirely removed. Although the author considered the insolubility of calciu oxalate in acetic acid to be a fact, a diligent search of the literature revealed information about its application to quantitative analysis. Two German referenc were found,[2] the first qualitative and the second only semi-quantitative. The were at least two references in English,[3] but these were only qualitative. It wa therefore, thought advisable to carry out some experimental work to see if th method gave reasonable results and could be incorporated in the proposed schem Many experiments were made using very pure calcium carbonate and as a resu the author feels that he has no hesitation in recommending the precipitation calcium as the oxalate in acetic acid. The precipitation is entirely quantitativ anywhere between 0·5N. and 5N. as to acid concentration, though it is ver crystalline at 0·5N. and very flocculent and difficult to filter at 5N. It is, therefor recommended that precipitation should take place from a boiling solution som where between 1N. and 3N. as to acid concentration. Under these conditions th

[1] Metamorphosed calcareous greywacke from Scotland, analysed by A. W. Groves (in M Macgregor, Quart. Journ. Geol. Soc. London, 1937, vol. 93, p. 469): SiO_2 53·91, TiO_2 0·8 Al_2O_3 7·55, Fe_2O_3 0·34, FeO 3·43, MnO 0·24, MgO 2·37, CaO 15·46, BaO nil, SrO nil, Na_2O 1·94 K_2O 1·85, P_2O_5 0·77, CO_2 10·30, H_2O+ 1·35, H_2O- 0·07 = 100·46.

[2] K. and V. Hoffmann, Anorganische Chemie. 8th edit., 1939, p. 304. C. T. L. Neubaue and K. H. Huppert, Die Analyse des Harns. 11th edit., 1913, vol. 2, p. 1607.

[3] H. J. Fenton, Notes on qualitative analysis. 2nd edit., 1942, p. 21. F. P. Treadwell an W. T. Hall, Analytical chemistry. 9th edit., 1937, vol. 1, p. 262.

ecipitate is crystalline and filters beautifully. No interference of any of the group was detected. Typical results are given below:

Taken $CaCO_3$ (grams).	Normality.	Found $CaCO_3$.
0·25	1	0·250
0·25	1	0·2499
0·05	$\frac{1}{2}$	0·0498
0·05	5	0·0499
0·50	2	0·501
0·50	2	0·500

With these results in mind it was decided to apply this method to the analysis calcium in rocks and minerals, thus avoiding the precipitation and removal of e iron group.

e direct estimation of calcium in rocks and minerals free of barium or strontium.

If the mineral or rock for analysis is known to contain no barium or strontium en the calcium may be determined without any fusion or separation whatsoever. ı example of this procedure is given below:

Experiment 2.—A calcium silicate (SiO_2 57·3, CaO 35 %, probably pecto-e) was crushed very finely and a 1-gram portion weighed into a platinum ucible and attacked with 20 ml. of perchloric acid and 20 ml. of hydrofluoric id and evaporated to dryness. It was then treated with 20 ml. of perchloric id and 20 ml. of water and heated for a few minutes, before being washed into beaker and diluted to 150 ml. with boiling water. The solution was crystal ear and the addition of 10 ml. 1/1 sulphuric acid produced no precipitate, show-g that no barium or strontium was present. The solution was made just kaline to litmus by ammonia from a drop bottle, 20 ml. of glacial acetic acid as added, followed after boiling a few minutes, by 25 ml. of a saturated solution ammonium oxalate. A heavy white precipitate formed at once and after iling and allowing to stand an hour, the solution was filtered off, washed with t dilute acid, burnt off at high temperature, and weighed as CaO. The result, ·56 % CaO, agreed very closely with that found in duplicate by an experienced alyst using the normal fusion attack. It will thus be seen that the hydroxides the R_2O_3 group do not interfere; if much manganese is present a small per-ntage may be co-precipitated with the calcium oxalate, but this will be seen by e discoloration, and after weighing it may easily be determined either colori-etrically or volumetrically by normal methods and subtracted from the result.

The direct estimation of calcium in rocks and minerals containing barium and/or strontium.

In order to test the recovery by this direct method of calcium in the presence barium and/or strontium it was decided to use a mineral free of any of these ements and to add to it varying amounts of calcium, barium, and strontium. ccordingly a sample of serpentine ($H_4Mg_3Si_2O_9$) was chosen and this was ound very finely and four separate portions *A*, *B*, *C*, *D* of 1 gram were weighed t into platinum crucibles; nothing was added to *A*, 0·1 gram of barium sulphate as added to *B*, 0·1 gram of strontium sulphate was added to *C*, while to *D* was ded 0·1 gram barium sulphate and 0·1 gram calcium carbonate. To each ucible was added 20 ml. perchloric acid (60 %) and 10 ml. hydrofluoric acid and e solution evaporated to dryness, when a further 20 ml. perchloric acid and 10 ml.

hydrofluoric acid were added and the solution evaporated once more to dryness. They were then treated with 20 ml. of perchloric acid, washed into a beaker and diluted to 200 ml. with boiling water, and 1 ml. of H_2SO_4 added. *A* remained perfectly clear showing no barium present, *B* gave an immediate heavy precipitate indicating barium, *C* remained clear showing no barium, whilst *D* gave a heavy white precipitate indicating barium. To each was added 10 ml. of sulphuric acid and the solutions were evaporated to 100 ml. *A* remained perfectly clear thus showing no barium or strontium, whilst *C* now gave a heavy white precipitate thus indicating strontium to be present. *B*, *C*, *D* were filtered off, washed free of acid, burnt off, and weighed. The filtrate of *D* was made just ammoniacal and then acid with 20 ml. glacial acetic and 25 ml. saturated ammonium oxalate solution added to the boiling solution; a heavy white precipitate formed which after standing an hour was filtered off, washed free of acid with boiling water and dried, burnt off, and weighed as CaO. The results found are given below:

Taken.	Found $BaSO_4$.	Found $SrSO_4$.	Found $CaCO_3$.
A, Serpentine only	nil	nil	nil
B, Serpentine plus 0·1 gram $BaSO_4$	0·1005	—	—
C, Serpentine plus 0·1 gram $SrSO_4$	—	0·0998	—
D, Serpentine plus 0·1 gram $BaSO_4$ and 0·1 gram $CaCO_3$	0·1003	—	0·1002

It was observed that in this mineral, which contained much iron, the barium sulphate was slightly discoloured owing to iron and this doubtless accounted for the slightly higher results; this was overcome later by washing the precipitate with hot 1 % hydrochloric acid.

It will thus be seen that it is possible to separate barium and strontium completely in the acid stage, and then to recover the calcium without any interference from the iron group. It will also be seen that it is possible to separate barium and/or strontium from calcium, and even to distinguish barium from strontium if either is present alone. It must be pointed out, however, that if these elements are both present the barium will co-precipitate most of the strontium on mere dilution, whilst addition of 10 ml. 1/1 sulphuric acid and evaporation to about 100 ml. will bring down all the strontium with barium. It has not yet been found possible to establish conditions where the strontium can be clearly separated from barium in perchloric acid.

In conclusion the author wishes to express his thanks to Dr. A. W. Groves and Dr. Max H. Hey for friendly discussion. Thanks are also due to the Directors of Messrs. International Alloys Ltd., Aylesbury, in whose laboratories these experiments were carried out, for permission to publish.

Summary.—It has been shown that provided the rock or mineral has been powdered to a sufficient fineness (e.g. 150–200 mesh) even the most refractory materials such as ilmenite, garnet, staurolite, and tourmaline may be opened up by the perchloric-hydrofluoric acid attack. It has also been shown that if barium and/or strontium are present they can be removed by simple addition of sulphuric acid and filtration, since calcium is entirely unaffected by this procedure. Finally it has been shown that, if desired, the calcium may be extracted as oxalate in acetic acid solution without precipitation of the Fe group, and without contamination by this group.

te on the determination of the orientation of section planes of meteoritic irons.

By P. Terpstra.

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[Communicated by Dr. M. H. Hey; read March 28, 1946.]

ECENTLY Dr. M. H. Hey published in this journal[1] a method to construct graphically a projection showing the relation of two etched surfaces M and o the crystallographic axes of a mass of the Gibeon meteoritic shower. Upon e faces could be distinguished the traces of four octahedron planes o_1, o_2, o_3, o_4 h are inclined at the following angles, measured clockwise from the inter- ion $[MN]$ of the etched surfaces: on surface M 22°, 62°, 98°, and 135°, and he same octahedron planes on surface N 106°, 38°, 150°, and 86° respectively.

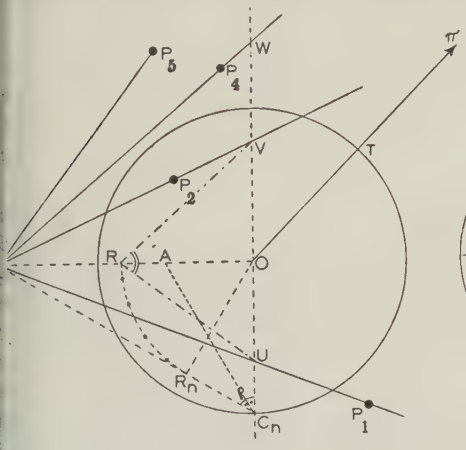

Fig. 1.

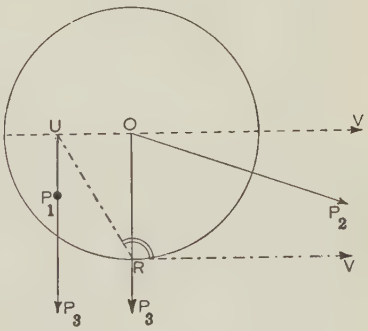

Fig. 2.

e two faces M and N are at an angle of 84° one to the other. Hey's solution he problem is based on a reversal of the Goldschmidt construction for drawing stals from the gnomonic projection. This method uses the 'angle-points' inkelpunkte) of the linear projections of the planes M and N. The construction legant, but it is rather cumbersome in consequence of the many lines that have be drawn (in Hey's fig. 2 the greater part of the auxiliary lines has been itted).

We found a simpler construction by taking into account, instead of the angle- nt A, another point which I have called[2] the 'radiant point' R. In the same nner as the angle-point of a gnomonic zone-line shows the angles between the

[1] M. H. Hey, Min. Mag., 1942, vol. 26, pp. 141–166.

[2] P. Terpstra, Kristallometrie. Groningen, 1946, p. 17.

planes of that zone, so the radiant point R of a gnomonic pole indicates ... angles between the traces wherein the plane, figured by that gnomonic pol... intersected by other planes. In fig. 1 the origin C of the gnomon is below ... plane of the drawing vertically under the point O at a distance equal to the r... of the circle. The angle between the 'zone-planes' P_3P_1C and P_3P_2C equals ... angle between the traces of the planes P_1 and P_2 on the plane P_3. This angle ... therefore be found by bringing a plane through the point O which is norma... the line P_3C (the intersection of P_3P_1C and P_3P_2C) in a point R'. Hinging t... plane on UV to the plane of projection, the point R' is brought to R and U...

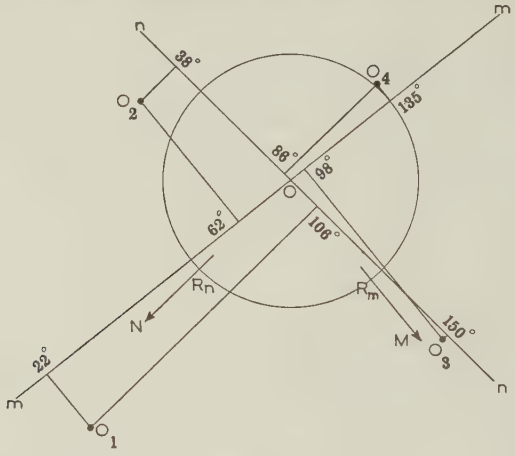

FIG. 3.

is the angle between the traces of the planes p_1 and p_2 on the plane p_3; likew... URW is the angle between the traces of p_1 and p_4 on p_3, &c. Taking into acco... the above-mentioned construction of the radiant point, it will at once be cl... that O is its own radiant point, whereas the radiant point of a pole π at infi... is the point T upon the gnomonic circle.

Calling in fig. 1 $OC_n = r$ and angle $OC_nP_3 = \rho$, one finds $OR = OR_n = r.\sin\rho$. Moreover, the point A is the angle-point of the zone-line whose pole i... P_3, if angle $OC_nA = \frac{1}{2}\rho$, and therefore $OA = r.\tan\frac{1}{2}\rho$. In the case of a poi... at infinity $\rho = 90°$ and hence $r.\sin\rho = r.\tan\frac{1}{2}\rho = r$, so that in this special c... the radiant point and the angle-point coincide in the point T.

Turning now to fig. 2, one recognizes the construction by the radiant-po... method of the angle between the traces wherein the vertical plane p_3 is intersec... by the plane p_1 and by a second vertical plane p_2. The zone-line $[p_1\ p_3]$ is ... parallel to OP_3, whereas the zone-line $[P_2\ P_3]$, being the line at infinity, interse... the line UO in the point V at infinite distance.

Hey's problem is dealt with in fig. 3. The faces M and N have been put ... vertical positions and their radiant points are R_m and R_n respectively. In ... the line corresponding with the intersection of the faces M and N is the tang... to the gnomonic circle. Measuring clockwise, lines should be drawn through ... point R_m that are inclined at the angles 22°, 62°, 98°, and 135° to that tange... and further, the intersections of those lines with the line mm should be determi...

apid method to find those intersections is the application of a gnomonic tractor, which gives the required points directly without any construction of s. These points have to be connected with the gnomonic pole of the face M, lines have to be drawn normal to mm. The same procedure has been applied V and nn. Thereafter the poles of the planes o_1, o_2, o_3, o_4 are found directly s indicated in the figure.

t is worth while to observe that this construction does not necessarily depend the radiant-point method, since the points R_m and R_n are also the angle- nts of M and N, and mm and nn respectively are the corresponding guide- s. Hence the reversed Goldschmidt construction that was applied by Hey . the radiant point method are identical for this special case.

he writer is indebted to Dr. M. H. Hey for his valuable criticisms.

ummary.—A simple graphical construction is described for the orientation of etched faces M and N of a meteoritic iron from the Widmanstetter figures.

Seventeenth list of new mineral names.[1]

By L. J. Spencer, C.B.E., M.A., ScD., F.R.S.
Formerly Keeper of Minerals in the British Museum.

[Communicated June 6, 1946.]

Al-chamosite. [L. M. Miropolsky, 1936. Uchen. Zapis. Kazan. Univ., v 96, no. 3, p. 70.] O. M. Shubnikova, Trans. Inst. Geol. Sci. USSR, 1938 11 (Min. Geochem. Ser., no. 3), p. 13 (Алшамозит, алюминиевый шамоз Al-chamosite). An oolitic chamosite rich in alumina (Al_2O_3 37·14%), Bashkir republic, Russia. [M.A. **9**–185.]

Alpha-vredenburgite. B. Mason, 1943. Geol. För. Förh. Stockholm, vol p. 263 (Alpha-vredenburgite), pp. 157, 268 (α-vredenburgite). Homogene tetragonal $(Mn,Fe)_3O_4$, as distinct from the usual mixture of cubic and tetrago $(Mn,Fe)_3O_4$ distinguished as β-vredenburgite. [M.A. **9**–37.]

Alumino-chrysotile. D. P. Serdyuchenko, 1945. Compt. Rend. (Dokla Acad. Sci. URSS, vol. 46, p. 117. Chrysotile containing Al_2O_3 5·68%, in series serpentine-parakaolinite, $H_4(Mg_3,Al_2)Si_2O_9$; from Caucasus. [M.A. **9**–18

Aurosmiridium. Dana's System of mineralogy, 1944, 7th edit., vol. 1, p. 1 Another spelling of aurosmirid (14th List).

Banalsite. W. C. Smith, F. A. Bannister, and M. H. Hey, 1944. Min. Ma vol. 27, p. 33; Nature, London, vol. 154, p. 336. W. C. Smith, Min. Mag., 19 vol. 27, p. 63. A barium-felspar with sodium, $BaNa_2Al_4Si_4O_{16}$, as orthorhom crystals from Benallt mine, Wales. Named from the chemical formula.

Barium-plagioclase. S. R. Nockolds and E. G. Zies, 1933. Min. Mag., v 23, p. 448 (barium plagioclase), p. 454 (barium anorthite, 13th List; not barium anorthite = celsian of H. Sjögren, 1895, 1st List). E. R. Segnit, M Mag., 1946, vol. 27, p. 171 (barium-plagioclase). Plagioclase containing B 3–5% from Broken Hill, New South Wales.

Bastinite. D. J. Fisher, 1945. Program and Abstracts, Min. Soc. Amer., 2 Annual Meeting, p. 9; Rep. Invest. Geol. Surv. South Dakota, 1945, no. 50, p. Amer. Min., 1946, vol. 31, p. 192. Lithium phosphate with some iron and ma ganese, as colourless triclinic crystals on fractured surfaces of lithiophilite, fr Custer, South Dakota. Named after Prof. Edson Sunderland Bastin (187 of the University of Chicago. [M.A. **9**–262.]

Belomorite, Беломорит. Trade-name for moonstone from the White S (Белое Море). A. E. Fersman, Precious and coloured stones of USS Leningrad, 1925, vol. 2, p. 30. [M.A. **9**–146.]

[1] Previous lists in this series have been given every three years at the ends of vols. 11- (1897–1943) of this Magazine. The 1560 names in the first ten lists are included in one alph betical arrangement in the General Index (1926) to vols. 11–20 (1895–1925). References 'Mineralogical Abstracts' are given in the form [M.A. **9**–].

eryllium-orthite. P. Quensel, 1945. Arkiv Kemi, Min. Geol., vol. 18A, 22 (Beryllium orthit). Beryllium-bearing (BeO 3·83%) orthite, regarded as a nym of muromontite. [M.A. **9**–257.]

eta-vredenburgite. M. Fleischer, 1944. Amer. Min., vol. 29, p. 247. β-lenburgite of B. Mason, Geol. För. Förh. Stockholm, 1943, vol. 65, pp. 157, *See* Alpha-vredenburgite.

eyerite. C. Frondel, 1943. Amer. Min., vol. 28, p. 532. E. W. Heinrich, ibid., , vol. 31, p. 198. Carbonate of bismuth (and calcium) as minute tetragonal als and earthy masses from Schneeberg, Saxony, and Pala, California. ed after Adolph Beyer (1743–1805), mining engineer of Schneeberg, Saxony, in 1805 recognized 'luftsaures Wismuth'. Not to be confused with bayerite h List). [M.A. **9**–6.]

ismuth-parkerite. J. W. du Preez, 1944. Ann. Univ. Stellenbosch, vol. 22, A, p. 101 (Bismuth-Parkerite). Parkerite (14th List), originally described as ckel sulphide, has been found to contain also bismuth and lead. The end-nbers bismuth-parkerite and lead-parkerite form mixed crystals in the system Bi_2S_2–$Ni_3Pb_2S_2$. [M.A. **9**–5, 126.]

lakeite. C. Frondel and F. H. Pough, 1944. Amer. Min., vol. 29, p. 211. ydrous ferric tellurite as reddish-brown microcrystalline (cubic?) crusts from dfield, Nevada. Named after Professor William Phipps Blake (1826–1910), was the first to recognize tellurium minerals in California. [M.A. **9**–62.]

lastonite. R. E. van Alstine, 1944. Econ. Geol., vol. 39, p. 117. Local name brecciated fluorite in a matrix of cryptocrystalline quartz from Newfoundland. A. **9**–252.]

rasilianite. F. H. Pough and E. P. Henderson, 1945. Mineração e Metalurgia, de Janeiro, vol. 8, p. 334 (Brasilianita); Anais Acad. Brasileira Cienc., vol. 17, 5 (Brasilianite); Amer. Min., vol. 30, p. 572 (Brazilianite). Hydrous phosphate luminium and sodium, $Al_3Na(PO_4)_2(OH)_4$, as yellow-green monoclinic crystals em quality, from Brazil. Named from the locality. [Not the brazilianite of Mawe, 1818 (= wavellite), A. H. Chester, 1896.] [M.A. **9**–186.]

alciocelsian. E. R. Segnit, 1946. Min. Mag., vol. 27, p. 169. Celsian, taining CaO 4%, from Broken Hill, New South Wales.

alogerasite. C. P. Guimarães, 1944. Mineração e Metalurgia, Rio de eiro, vol. 8, p. 135; Anais Acad. Brasileira Cienc., vol. 16, p. 255 (Calogerasita). onym of simpsonite (15th List). Named after João Pandiá Calogeras (1870–5). [M.A. **9**–127, 186.]

attierite. P. F. Kerr, 1945. Amer. Min., vol. 30, pp. 483, 498. Cobalt lphide, CoS_2, cubic with pyrite structure, from Shinkolobwe, Belgian Congo. ned after Felicien Cattier, chairman of the Union Minière du Haut Katanga. A. **9**–188, 224.]

hirvinskite. N. K. Platonov, 1941. Compt. Rend. (Doklady) Acad. Sci. SS, vol. 33, p. 361 (chirvinskite). A metamorphosed bitumen near shungite anthraxolite, representing a stage in the alteration to graphite, from Caucasus.

Named after Prof. Petr Nikolaevich Chirvinsky, Петр Николаевич Чирвинс (1880–). [M.A. **9**–125.]

Chloritoserpentine. *See* Serpochlorite.

Christensenite. T. F. W. Barth and A. Kvalheim, 1944. Sci. Results wegian Antarctic Expeditions 1927–28, Norske Vidensk.–Akad. Oslo, n A solid solution of nepheline (5%) in tridymite, from Deception Island, Anta Named after Lars Christensen (1884–), consul and shipowner of Sande Norway, who instituted and financed the expeditions. [M.A. **9**–261.]

Chromamesite. [I. A. Zimin, Mineralnoe Syre, Moscow, 1935, no. 10, p. O. M. Shubnikova, Trans. Inst. Geol. Sci. USSR, 1938, no. 11 (Min. Geo Ser., no. 3), p. 12 (Хромистый амезит, Chrom-amesite), p. 13 (хромам p. 35 (Chromamesite). Analysis of amesite from the Urals containing 0·77% is interpreted as a mixture of the molecules $H_4Mg_2Al_2SiO_9$ (am 95·6%, $H_4Fe_2Al_2SiO_9$ (daphnite) 3%, and $H_4Mg_2Cr_2SiO_9$ (chromamesite) 1·4

Conchilites. T. L. Tanton, 1944. Trans. Roy. Soc. Canada, ser. 3, vo sect. 4, p. 99. Shell-shaped concretions of limonite. Named from *κόγχη* sh and *λίθος* stone. [M.A. **9**–127.]

Cosmolite. Synonym of meteorite; probably much earlier than M. Se Publ. Manila Observatory, 1930, vol. 1, no. 9, p. 25 (kosmolite), p. 51 (cosmo cosmolito), applied to meteorites and tektites. F. C. Leonard, Popular Astrono Northfield, Minnesota, 1944, vol. 52, p. 352, reprinted in Contributions to Society for Research on Meteorites, 1945, vol. 3 (for 1944), p. 161, 'in view of cosmic origin of meteorites, it is perhaps unfortunate that they were not terr *cosmolites*'. [M.A. **4**–442, **9**–289.]

Daunialite. C. Andreatta, 1943. L'Industria Mineraria d'Italia e d'Oltrem Faenza, April, 1943, no. 4, reprint p. 22. A siliceous montmorillonitic clay sedimentary origin, containing 25% of organic silica, as distinct from bento of volcanic origin. Named from the locality Castelnovo della Daunia, Pug Italy. [M.A. **9**–263.]

Eckermannite. O. J. Adamson, 1942. Geol. För. Förh. Stockholm, vol. p. 329; ibid., 1944, vol. 66, p. 194. An alkali-amphibole containing Na_2O 11 K_2O 2·41%, $Na_4Mg_2AlFe'''(Si_4O_{11})_2(O,OH,F)_2$, from Norra Kärr, Sweden. Na after Professor Claes Walther Harry von Eckermann (1886–) of Stockho [M.A. **9**–87.]

Ferrikaolinite. D. P. Serdyuchenko, 1945. Compt. Rend. (Doklady) Ac Sci. URSS, vol. 46, p. 118. Hypothetical molecule $H_4Fe_2Si_2O_8$, correspondin kaolinite.

Ferropigeonite. W. N. Benson, 1944. Trans. Roy. Soc. New Zealand, 74, p. 115 (ferropigeonite), p. 117 (ferro-pigeonite). Pigeonite (restricted material with optic axial angle 2V 0–30°) is subdivided into magnesian pigeon pigeonite, and ferropigeonite. Pigeonite of other authors with 2V 30–45° is cal subcalcic augite. [M.A. **9**–151.]

errotine. O. M. Shubnikova, Trans. Lomonosov Inst. Acad. Sci. USSR, 7, no. 10, p. 223 (Ферротин, Ferrotine). Fe_nO_{n+1} (FeO 61·30, Fe_2O_3 33·20%), ngly magnetic scales and grains from a river in Siberia. (Evidently partially lized magnetite.)

errotschermakite. A. N. Winchell, 1945. Amer. Min., vol. 30, p. 29. A othetical molecule $Ca_2Fe_3''Fe_2'''Al_2Si_6O_{22}(OH)_2$ to explain the composition of minous amphiboles. *See* Tschermakite. [M.A. **9**–271.]

ormanite. H. Berman and C. Frondel, 1944. Dana's System of mineralogy, edit., vol. 1, p. 757. Tantalate of yttrium, &c., $YtTaO_4$, corresponding with the ate fergusonite, from Cooglegong, Western Australia, analysed by E. S. pson (1909). Named after Francis Gloster Forman, government geologist of stern Australia.

ranquenite. R. Van Tassel, 1944. Bull. Mus. Hist. Nat. Belgique, vol. 20, 16, p. 9. Hydrous sulphate of iron, aluminium, and magnesium, $2(Mg,Fe)SO_4$. e,Al)$OHSO_4.41H_2O$, as yellow efflorescences from Franquenies, Belgium. ned from the locality. [M.A. **9**–125.]

Gamagarite. J. E. de Villiers, 1943. Amer. Min., vol. 28, p. 329. Vanadate arium, iron, and manganese, $Ba_4(Fe,Mn)_2V_4O_{15}(OH)_2$, as dark-brown mono- ic needles in manganese ore from Gamagara ridge, Postmasburg, South ica. Named from the locality. [M.A. **9**–5.]

Genthelvite. J. J. Glass, R. H. Jahns, and R. E. Stevens, 1944. Amer. Min., . 29, p. 178. The zinc end-member, $Zn_4Be_3Si_3O_{12}S$, of the helvine group. med from helvine and after Prof. Frederick Augustus Louis Charles William ith (1820–1893), of Philadelphia, who in 1892 described, under the name alite, a single crystal containing 85% of this component. [M.A. **9**–62.]

Glaucopargasite. P. R. J. Naidu, 1944. Quart. Journ. Geol. Mining Metall. . India, vol. 16, p. 138. A blue amphibole from Mysore intermediate in mposition between glaucophane and pargasite. [M.A. **9**–189.]

Groutite. J. W. Gruner, 1945. Amer. Min., vol. 30, p. 169. $HMnO_2$ as ortho- mbic crystals of the diaspore group distinct from manganite, from Cuyuna ge, Minnesota. Named after Professor Frank Fitch Grout (1880–) of the iversity of Minnesota. [M.A. **9**–126.]

Gumbrine. A. A. Tvalchrelidze, 1929. [Гумбрин — фуллерова земля из мбри. Gumbrine—fuller's earth from Gumbri. Pamphlet issued by the trust the mining-chemical industries of Georgia, Tiflis]; Mineral resources of rgia, edited by S. A. Godabrelidze, Tiflis, 1933, p. 148 (Гумбрин, Russian), x (გუმბრინი, Georgian), p. xv (goumbrine, French). Fuller's earth, similar loridine (10th List), from Gumbri (Гумбри) near Kutais, Georgia (Грузия), nscaucasia. Named from the locality. [M.A. **3**–68, **8**–106.]

Hanušite. J. V. Kašpar, 1942. Chem. Listy, Praha, vol. 36, no. 6, p. 78 nušit). Hydrated magnesium silicate, $H_2Mg_2(SiO_3)_3.H_2O$, an alteration duct of pectolite from Bohemia. Named after Josef Hanuš (1872–), professor nalytical chemistry in the Technical Institute, Praha. [M.A. **9**–6, 260.]

Haringtonite. N. W. Wilson, 1945. Bull. Inst. Mining Metall. London, 470, p. 12. A provisional name for an unidentified mineral resembling gu cazarite, from Harington Kop, Murchison Range, Transvaal. (Not to be fused with harringtonite of T. Thomson, 1831.) [M.A. **9**–127.]

Hedleyite. H. V. Warren and M. A. Peacock, 1945. Univ. Toronto Stu Geol. Ser., no. 49, p. 55. Bismuth-tellurium alloy Bi_7Te_3, a solid solution of in Bi_2Te_3, as rhombohedral cleavage flakes, from Hedley, British Colu Named from the locality. [M.A. **9**–126.]

Hedroicite. O. M. Shubnikova, Trans. Inst. Geol. Sci. USSR, 1940. 31 (Min.-Geochem. Ser. no. 6), p. 46. Another transliteration of гедро gedroitzite (15th List).

Hematophanite. Dana's System of mineralogy, 1944, 7th edit., v p. 728. Another spelling of haematophanite (12th List).

Hydroallanite. E. S. Simpson, 1938. Journ. Roy. Soc. Western Aust vol. 24 (for 1937–38), p. 113. Hydrated variety of allanite from Coogleg Western Australia.

Hydrogadolinite. E. S. Simpson, 1938. Journ. Roy. Soc. Western Aust vol. 24 (for 1937–38), p. 113. Hydrated variety of gadolinite from Coogleg Western Australia.

Hydrogrossular. C. O. Hutton, 1943. Trans. Roy. Soc. New Zealand, 73, p. 174 (Hydrogrossular). For members of the series $3CaO.Al_2O_3.3Si$ $3CaO.Al_2O_3.6H_2O$ between grossular and hibschite (= plazolite, $3CaO.Al_2$ $2SiO_2.2H_2O$). Compare garnetoid, grossularoid, and hydrogarnet (16th L [M.A. **9**–61.]

Hydrolepidocrocite. B. P. Krotov, 1936. Compt. Rend. (Doklady) A Sci. URSS, 1943, vol. 40, p. 115 (Hydrolepidokrokite). A. E. Fersman and O. Shubnikova, Sputnik geokhimika i mineraloga, 1937, p. 137 (Гидролепидокрок Lepidocrocite with adsorbed water, γ-FeOOH.aq, dimorphous with hyd goethite (α-FeOOH.aq). The hydrogoethite (3rd List) originally described is reality hydrolepidocrocite. [M.A. **9**–62.]

Iron-talc. J. W. Gruner, 1944. Amer. Min., vol. 29, p. 363 (iron talc). Minnesotaite.

Jusite. I. Gramling-Mende and G. Leopold, 1943. Neues Jahrb. Min. Mon hefte, Abt. A, 1943, p. 178 (Jusit). Hydrated silicate of calcium with so alumina (8·23%) and alkalis (3·61%), '$(Si,Al)_6(Ca,Na,K)_5.5H_2O$', as w radiating needles, probably orthorhombic. Named from the locality, J Schwäbische Alb, Württemberg. [M.A. **9**–37.]

Kerchenite. Another spelling of kertschenite (4th List), being the Engl transliteration of керченит, from Kerch (Керчь), Crimea. [M.A. **9**–92, 311.]

Kladnoite. R. Rost, 1942. Rozpravy České Akad., 1942, vol. 52, no. (Kladnoit). An organic compound $C_6H_4(CO)_2NH$ (phthalimide) as monocli crystals formed in burning waste heaps in the Kladno coal basin, Bohem Compare kratochvilite (15th List). Named from the locality. [M.A. **9**–186.]

Corunduvite. N. G. D'Ascenzo, 1945. The gem-table, Philadelphia, Pennsylvania. To replace the name corundum, because of the confusion with carborundum [and conundrum]. From the Sanskrit kuruvinda. [M.A. **9**–191.]

Kribergite. T. Du Rietz, 1945. Geol. För. Förh. Stockholm, vol. 67, p. 78 (kribergit). Hydrated phosphate and sulphate of aluminium, $2Al_2O_3.2(P_2O_5,SO_3)$. H_2O, as white chalk-like masses from Kristineberg mine, Västerbotten, Sweden. Named from the locality. [M.A. **9**–188.]

Kyanophilite. B. R. Rao, 1945. Current Sci. Bangalore, vol. 14, p. 196 (kyanophylite). Hydrous silicate of aluminium, as apple-green lumps in association with kyanite-graphite-schist in Mysore. Named from kyanite and *φίλος*, friend. [M.A. **9**–188.]

Landsbergite. D. R. Hudson, 1943. Metallurgia, Manchester, vol. 29, p. 56. Abbreviation of the name moschellandsbergite (15th List). Named from the locality, Landsberg, near Ober-Moschel, Rhenish Bavaria. [M.A. **9**–55.]

Lead-parkerite. J. W. du Preez, 1944. Ann. Univ. Stellenbosch, vol. 22, sect. 4, p. 101 (Lead-Parkerite). *See* Bismuth-parkerite.

Libyanite. C. Fenner, 1937. Newspaper article in 'The Australasian', Melbourne, October 2, 1937. Silica-glass from the Libyan Desert. (Native silica-glass had already been named lechatelierite, 7th List.) [Min. Mag., **25**–425.]

Livite. L. A. Kulik, 1941. Meteoritica, Acad. Sci. USSR, vol. 1, p. 75 (*Ливит* . Кварцевое стекло из Ливии) [*sic*]), p. 122 (Livit . . . Silica glass). Incorrect form of libyanite (q.v.). [M.A. **9**–295.]

Lomonosovite. 'A sodium phosphate-titanium silicate' occurring with inglusuite and nordite in the Kola peninsula, mentioned without description by V. I. Gerasimovsky, Compt. Rend. (Doklady) Acad. Sci. URSS, 1941, vol. 32, p. 498. Named after the pioneer Russian mineralogist Michael Vasilevich Lomonosov, Михаил Васильевич Ломоносов (1711–65). [M.A. **8**–279.]

Mackayite. C. Frondel and F. H. Pough, 1944. Amer. Min., vol. 29, p. 211. Hydrous tellurite of iron, perhaps $Fe_2(TeO_3)_3.xH_2O$, as green tetragonal crystals from Goldfield, Nevada. Named after John William Mackay (1831–1902), an Irishman who made a great fortune on the Comstock lode in Nevada. [M.A. 62.]

Magaugite. F. Walker, 1943. Amer. Journ. Sci., vol. 241, p. 518. Alternative name for endiopside [16th List] for augite rich in magnesium. [M.A. **9**–151.]

Mahadevite. S. Ramaseshan, 1945. Proc. Indian Acad. Sci., Sect. A, vol. 22, p. 177. A bronze-coloured mica intermediate in composition between muscovite and phlogopite, from Warangal, Hyderabad. Named after Professor C. Mahadevan of Andhra University. [M.A. **9**–189.]

Manganese-chlorite. H. von Eckermann, 1927. Geol. För. Förh. Stockholm, vol. 49, p. 450; 1944, vol. 66, p. 721. A chlorite from Långban, Sweden, containing 6% MnO. (The manganchlorite of A. Hamberg, 1890, contained 2·28% MnO.) [M.A. **3**–474, **9**–256.]

Manganese-merwinite. H. J. Goldschmidt and J. R. Rait, 1943. Natu... London, vol. 152, p. 356 (manganese-merwinite). A slag mineral, 3... $MnO.2SiO_2$, analogous to merwinite with Mn in place of Mg. [M.A. **9**–102.]

Mansfieldite. V. T. Allen and J. J. Fahey, 1945. Program and Abstr... Min. Soc. Amer., 26th Annual Meeting, p. 7; Amer. Min., 1946, vol. 31, p. 1... Hydrated aluminium arsenate, $AlAsO_4.2H_2O$, isomorphous with scorodite, ... white cellular crusts in clay from Hobart Butte, Oregon. Named after ... George Rogers Mansfield (1875–) formerly of the United States Geological Sur... [M.A. **9**–262.]

Minnesotaite. J. W. Gruner, 1944. Amer. Min., vol. 29, p. 363. Hyd... silicate of ferrous iron (magnesium, &c.), $(OH)_{5\cdot5}(Fe'',Mg)_{5\cdot5}(Si,Al,Fe''')_8O_{1}$... with the crystal-structure of talc and regarded as an iron-talc, of abun... occurrence in iron ores in Minnesota. Named from the locality. [M.A. **9**–88...]

Montbrayite. M. A. Peacock and R. M. Thompson, 1945. Program a... Abstracts, Min. Soc. Amer., 26th Annual Meeting, p. 21; Amer. Min., 1946, v... 31, p. 204. Gold telluride, Au_2Te_3, as tin-white triclinic crystals from Montb... Quebec. Named from the locality. [M.A. **9**–262.]

Nagolnite. G. Vavrinecz, 1936. Földtani Közlöny, Budapest, vol. 66, p. 2... 1937, vol. 67, p. 60 (Nagolnit). Hypothetical molecule $H_4Al_2SiO_7$ as a constitue... of many orthochlorites, corresponding to V. I. Vernadsky's chlorite acid $H_2...$ $SiO_6(+H_2O)$, and approximating in composition to Y. V. Samoilov's α-chlorit... (7th List) from Nagolno, Donetz, Russia. Named from the locality. [M.A. **7**–36...]

Němecite. J. V. Kašpar, 1941. Rozpravy České Akad., 1941, vol. 51, no. ... (němecit); Bull. Internat. Acad. Sci. Bohême, 1943, vol. 43 (for 1942), p. 27... Hydrous ferric silicate, $H_4Fe_2Si_2O_9.5H_2O$, as a limonite-like encrustation ... pyrrhotine from Chiuzbaia (= Kisbánya), Romania. Named after Alois Něme... mineral collector and engineer, of Přerov, Moravia. Probably identical wi... hisingerite and canbyite (10th List). [M.A. **9**–186.]

Neodigenite. P. Ramdohr, 1943. Zeits. Prakt. Geol., vol. 51, pp. 1, 9 (Ne... digenit). Cubic Cu_9S_5 in the system Cu_2S–CuS, and in copper ores. The origin... digenite (A. Breihaupt, 1844) of approximately this composition is a mixture ... chalcosine and covelline, but N. W. Buerger [M.A. **7**–482; **8**–254, 364) has tra... ferred the name digenite to cubic Cu_9S_5. [M.A. **9**–263.]

Neoglauconite [A. V. Kazakov, 1938. Trans. Sci. Inst. Fertilizers, Mosco... no. 140, p. 146.] O. M. Shubnikova, Trans. Inst. Geol. Sci. USSR, 1940, nô. ... (Min.-Geochem. Ser., no. 6), p. 45 Неоглауконит, Neoglauconite). A variet... of glauconite of distinctive form and colour, from phosphorite mines in t... Moscow region.

Novoelpidite. Mentioned without description by V. I. Gerasimovsky, Comp... Rend. (Doklady) Acad. Sci. URSS, 1939, vol. 22, p. 263, as an associate ... chkalovite in the Kola peninsula. [M.A. **7**–314.]

Oakite. Mentioned by J. W. Gruner (Amer. Min., 1943, vol. 28, pp. 174, 615) ... due to W. E. Richmond. Tentative name for a supposed new manganese minera... afterwards identified with lithiophorite, from White Oak Mountain, Tennessee.

Oligonsiderite. F. Ulrich and R. Munk, 1936. Schlägel und Eisen, Teplitz-Sinau, reprint p. 10 (Oligonsiderit). Manganese concretions containing Fe_2O_3 43·73, $MnCO_3$ 33·31 % from Slovakia. Synonym of oligon-spar = oligonite. Not to be confused with oligosiderite in A. Daubrée's (1867) classification of meteorites.

Ondřejite. J. V. Kašpar, 1944. Věda Přírodní, Praha, vol. 23, p. 132 (Ondřejit). Hydrated carbonate and silicate of magnesium, calcium, and sodium, as a white powder on aragonite from Zbrašov caves, Hranice, Moravia. Named after Fr. Augustin Ondřej of the Technical High School of Praha. [M.A. **9**-261.]

Oxykerchenite. Another spelling of oxykertschenite (5th List). *See* kerchenite. [M.A. **9**–92, 311.]

Parakaolinite. D. P. Serdyuchenko, 1945. Compt. Rend. (Doklady) Acad. Sci. URSS, vol. 46, p. 117. End-member of the series serpentine-parakaolinite, $(Mg_3,Al_2)Si_2O_8$. *See* Alumino-chrysotile. [M.A. **9**–185.]

Parathuringite. O. Koch, 1884. Inaug.-Diss. Jena, p. 37 (Parathuringit). A mineral from Vogtland very similar to thuringite, but with the composition $Fe_5"Mg_2Si_6O_{31}.9aq.$

Partridgeite. J. E. de Villiers, 1943. Amer. Min., vol. 28, pp. 336, 468. Manganese and ferric oxide $(Mn,Fe)_2O_3$, differing from sitaparite in colour and staining reactions; from Postmasburg, South Africa. Named in memory of Francis Chamberlain Partridge (1903–1939), formerly of the Geological Survey of South Africa. [M.A. **9**–4, 5.]

Pennantite. W. C. Smith, F. A. Bannister, and M. H. Hey, 1946. Min. Mag., vol. 27, p. 217. A manganese-rich chlorite, $(Mn,Al)_6(Si,Al)_4O_{10}(OH)_8$, as orange-coloured optically uniaxial scales from Benallt manganese mine, Wales. Analogous to thuringite with MnO(39%) in place of FeO. Named after Thomas Pennant (1726–98), Welsh zoologist and mineralogist.

Phosphate-allophane. S. G. Gordon, 1929. Amer. Min., 1929, vol. 14, p. 105 (phosphate allophane); Proc. Acad. Nat. Sci. Philadelphia, 1944, vol. 96, p. 355 (phosphate allophane, Phosphate-Allophane). A variety of allophane containing P_2O_5 7·97%. [M.A. **9**–209.]

Polymignyte. Dana's System of mineralogy, 1944, 7th edit., vol. 1, p. 764. Another spelling of polymignite (J. J. Berzelius, 1824).

Protomelane. L. L. Fermor, 1945. Proc. South Wales Inst. Engin. vol. 61, p. 0. Barium-bearing psilomelane as distinct from potassium-bearing psilomelane (cryptomelane, 16th List). [M.A. **9**–189.]

Pseudo-apatelite. A. Magne, 1942. Bull. Soc. Franç. Min., vol. 65, p. 41 (pseudo-apatélite). Abstract in Amer. Min., 1945, vol. 30, p. 86 (Pseudoapatelite). $(Ca,Al)_2(OH)_4SO_4.H_2O$ or $5Fe_2O_3.2Al_2O_3.7H_2O.21H_2O$, described by A. Lacroix in 1910 as apatelite, but differing from the apatelite ($3Fe_2O_3.4SO_3.6H_2O$) of Meillet (1841) in containing Al_2O_3 11·0%. [M.A. **9**–126.]

Pseudokrokydolith. C. Hintze, Handbuch Min., Ergänzungsband, 1937, p. 14 (Pseudokrokydolith). German form of pseudo-crocidolite (6th List).

Pseudothuringite. O. Koch, 1884. Inaug.-Diss. Jena, p. 27 (Pseudothuring
A mineral from Vogtland very similar to thuringite, but with the compos
$Al_4Fe_4''Mg_2Si_3O_{18}.5aq$.

Rabdopissite. A. N. Krishtofovich, 1927. Bull. Com. Géol. URSS, vo
(for 1925), p. 57 (рабдописсит). O. M. Shubnikova, Trans. Inst. Geol.
USSR, 1940, no. 31 (Min. Geochem. Sér., no. 6), p. 61. Rods of brown bitumi
material (C 66·72, H 7·49, N 0·49, O + S 25·30%) in coal from Siberia. Named
ῥάβδος, a rod, *πίσσα*, pitch.

Ramsdellite. M. Fleischer and W. E. Richmond, 1943. Econ. Geol., vo
p. 278. Orthorhombic MnO_2 dimorphous with tetragonal pyrolusite (= polia
Named after Prof. Lewis Stephen Ramsdell (1895–) of the University of Mich
who described the material in 1932. [M.A. **5**–180, **9**–4.]

Saltspar. P. M. Murzaev, 1941. Compt. Rend. (Doklady) vol. 33, p.
(saltspar). Coarsely crystallized and cleavable halite. [M.A. **9**–127.]

Sebkhainite. L. Berthon, 1922. L'industrie minérale en Tunisie, p.
(Sebkhaïnite). Mixed salts containing carnallite (60%), epsomite, and halite fr
salt-pans (sebkhas) in Tunisia. Compare mellahite (11th List).

Serpochlorite or **Chloritoserpentine.** [A. A. Menyailov, 1935. Mat. P
Geol. Kuznetz Ala-tau, Acad. Sci. USSR, Ser. Siberia, no. 19, p. 64.] O.
Shubnikova, Trans. Inst. Geol. Sci. USSR, 1938, no. 11 (Geochem. Ser., no.
p. 14 (Серпохлорит, Serpochlorite, Хлоритосерпентин, Chlorite-serpentin
p. 35 (Chloritoserpentine). Undefined variety of blue-green chlorite occurring
serpentine rocks.

Sillenite. C. Frondel, 1943. Amer. Min., vol. 28, p. 525. Body-centred cu
modification of Bi_2O_3 as greenish waxy masses from Durango, Mexico. Nam
after Dr. Lars Gunnar Sillén of Stockholm, who prepared the material artificia
[M.A. **7**–234]. [M.A. **9**–6.]

Sjögrenite. J. S. Krenner, 1910. Compt. Rend. Congrès Géol. Intern.,
Session, 1910, Stockholm, 1912, vol. 1, p. 129 (Sjögrenit); Földtani Közlö
Budapest, 1913, vol. 43, pp. 10, 121. P. Quensel, Geol. För. Förh. Stockhol
1946, vol. 68, p. 110. Hydrous ferric phosphate, $5Fe_2O_3.3P_2O_5.8H_2O$, proba
triclinic. First described from Cornwall by E. Kinch, F. H. Butler, and H.
Miers (Min. Mag., 1886, vol. 7, p. 85) as distinct from dufrenite. Named after S
Anders Hjalmar Sjögren (1856–1922) of Stockholm. Not the sjögrenite of
Frondel, 1940 (16th List). [M.A. **9**–263.]

Tibergite. N. H. Magnusson, 1930. Avh. Sveriges Geol. Undersök., Ser.
no. 23, p. 46 (tibergit), p. 107 (tibergite). A brownish-purple variety of amphib
rich in alkalis, Al_2O_3 and Fe_2O_3, containing $R_2(Al,Fe)_4Si_2O_{12}$ in addition to t
richterite molecule; from Långban, Sweden. Named after Mr. H. V. Tibe
formerly manager of the Långban mines. [M.A. **9**–4.]

Titanhaematite. A. B. Edwards, 1938. Proc. Australasian Inst. Mining
Metall., n. ser., no. 110, p. 42 (titanohematite). C. O. Hutton, New Zeala
Journ. Sci. Techn., Sect. B, 1945, vol. 26, p. 299 (titanhaematite). Haematite wi

TiO_2 in solid solution, with dark brown to black streak. When more than about 1% of TiO_2 is present the excess separates out as intergrowths of ilmenite. [M.A. **9**–263.]

Titano-thucholite. G. Aminoff, 1943. Geol. För. Förh. Stockholm, vol. 65, p. 31 (Titano-Thucholite). O. H. Ödman, Årsbok Sveriges Geol. Unders., 1944, Ar. 38, no. 6, pp. 3, 7. A radioactive bituminous mineral differing from thucholite (4th List) in containing titanium (TiO_2 4·5%), from Boliden, Sweden. [M.A. **10**–37, 257.]

Trömelite. W. L. Hill, G. T. Faust, and D. S. Reynolds, 1944. Amer. Journ. Sci., vol. 242, p. 467, 545. An artificial calcium phosphate, perhaps $7CaO.5P_2O_5$. Named after Gerhard Trömel of Düsseldorf, who made the first systematic study of the system CaO–P_2O_5. [M.A. **9**–92.]

Tschermakite. A. N. Winchell, 1945. Amer. Min., vol. 30, pp. 29, 44. A hypothetical 'Tschermak molecule' $Ca_2Mg_3Al_4Si_6O_{22}(OH)_2$ to explain (together with the corresponding iron molecule $Ca_2Fe_3Fe_2'''Al_2Si_6O_{22}(OH)_2$, named ferrotschermakite) the composition of aluminous amphiboles. Named after Gustav Tschermak (1836–1927) of Vienna. Not the tschermakite of F. Kobell, 1873, a synonym of albite. [M.A. **9**–271.]

Vaesite. P. F. Kerr, 1945. Amer. Min., vol. 30, pp. 483, 498. Nickel disulphide, NiS_2, cubic with pyrite structure, from Kasompi mine, Belgian Congo. Named after Johannes Vaes, mineralogist to the Union Minière du Haut Katanga. [M.A. **9**–188, 224.]

Velikhovite. [I. V. Lopukhov, Mineralnoe Syre, Moscow, 1931, no. 2, pp. 152, 154.] O. M. Shubnikova, Trans. Inst. Geol. Sci. USSR, 1938, no. 11 (Min. Geochem. Ser., no. 3), p. 32 (Велиховит, Velikhovite). A bitumen (C 77·34, H 7·71, N 2·00, O 10·59, S 2·36) with shining conchoidal fracture. Named from the locality, Velikhov (Велихов), Urals.

Vernadite. A. G. Betekhin, 1944. Bull. Acad. Sci. URSS, Sér. Géol., no. 4, p. 35 (Вернадит), p. 45 (vernadite). Colloidal hydrated MnO_2 as a weathering product of manganese ores; considered to be a manganic acid H_2MnO_3, giving rise to salts of the psilomelane group. Named after Vladimir Ivanovich Vernadsky, Владимир Иванович Вернадский (1863–1945), who had predicted its existence. Distinct from vernadskite (6th List). [M.A. **9**–185.]

Viseite. J. Mélon, 1943. Ann. Soc. Géol. Belgique, vol. 66, Bull. p. 53 (viséite). Hydrous silico-phosphate of aluminium and calcium, $5Al_2O_3.5CaO.3SiO_2.3P_2O_5$. 5–$30H_2O$, as white, wart-like, optically isotropic masses. Named after the locality, Visé, Belgium. [M.A. **9**–88, 188.]

Yenerite. J. Steiger and O. Bayramgil, 1943. Schweiz. Min. Petr. Mitt., vol. 23, p. 616 (Yenerit). O. Bayramgil, ibid., 1945, vol. 25, p. 46. Sulphantimonite of lead, $11PbS.4Sb_2S_3$, between boulangerite and falkmanite (15th List); from Şikdağ, Turkey. Named after Hadi Yener, formerly director of M.T.A. (Maden Tetkik ve Arama Enstitüsü, Turkish Mining Research Institute). [M.A. **9**–37, 262.]

Zincselenide. H. Rose, 1927, Fortschr. Min. Krist. Petr., vol. 12, p. 73 (Zinkselenid). W. Geilmann and H. Rose, Neues Jahrb. Min. Geol., Abt. A,

1928, pp. 797, 803, 807. Dana's System of mineralogy, 7th edition, 1944, p. 2[illegible] (Zincselenide). An incompletely determined mineral, supposed to be selenide [illegible] zinc, occurring in selenium ores from Andreasberg, Harz. [M.A. **4**–76.]

Zirfesite. E. E. Kostyleva, 1945. Compt. Rend. (Doklady) Acad. Sci. URS[illegible] vol. 48, p. 502. Hydrous silicate of zirconium, iron, &c., $(ZrO_2,Fe_2O_3)SiO_2.nH_2O$ as a powdery clay-like mineral from the alteration of eudialyte in the Ka[illegible] peninsula. Named from the composition Zr,Fe,Si. [M.A. **9**–261.]

SYSTEMATIC CLASSIFICATION OF NEW MINERALS[1]

Sulphides, etc.

Vaesite, NiS_2.
Cattierite, CoS_2.
Neodigenite, Cu_9S_5.
Zincselenide, ZnSe ?
Montbrayite, Au_2Te_3.
Hedleyite, Bi_7Te_3.
Bismuth-parkerite, $Ni_3Bi_2S_2$.
Lead-parkerite, $Ni_3Pb_2S_2$.
Yenerite, $11PbS.4Sb_2S_3$.

Oxides.

Sillenite, Bi_2O_3.
Titanhaematite.
Ramsdellite, MnO_2.
Partridgeite, $(Mn,Fe)_2O_3$.
Alpha-vredenburgite, $(Mn,Fe)_3O_4$.

Hydroxides.

Hydrolepidocrocite, γ-FeOOH.aq.
Groutite, $HMnO_2$.
Vernadite, H_2MnO_3.

Carbonates.

Beyerite, carb. Bi, (Ca).
Ondřejite, hyd. carb. & sil. Mg, Ca, Na.

Sulphates.

Pseudo-apatelite, $(Fe,Al)_2(OH)_4SO_4.H_2O$.
Franquenite,
$2(Mg,Fe)SO_4.6(Fe,Al)OHSO_4.41H_2O$.

Phosphates, etc.

Bastinite, phos. Li, (Fe,Mn).
Trömelite, $7CaO.5P_2O_5$?
Brasilianite, $Al_3Na(PO_4)_2(OH)_4$.
Sjögrenite, $5Fe_2O_3.3P_2O_5.8H_2O$.
Kribergite, $2Al_2O_3.2(P_2O_5,SO_3).5H_2O$.
Viseite, $5Al_2O_3.5CaO.3SiO_2.3P_2O_5.25$–$30H_2O$.
Mansfieldite, $AlAsO_4.2H_2O$.
Gamagarite, $Ba_4(Fe,Mn)_2V_4O_{15}(OH)_2$.

Tantalates.

Formanite, $YtTaO_4$.

Tellurites.

Blakeite, $Fe_2(TeO_3)_3$?
Mackayite, $Fe_2(TeO_3)_3.xH_2O$.

Silicates.

Banalsite, $BaNa_2Al_4Si_4O_{16}$.
Calciocelsian.
Barium-plagioclase.
Belomorite = moonstone.
Ferropigeonite.
Eckermannite, alkali-amphibole.
Tibergite, alkali-amphibole.
Ferrotschermakite.
Glaucopargasite.
Beryllium-orthite.
Manganese-merwinite, $Ca_3MnSi_2O_8$.
Genthelvite, $Zn_4Be_3Si_3O_{12}S$.
Lomonosovite, Na, P_2O_5, TiO_2, SiO_2.
Zirfesite, $(ZrO_2,Fe_2O_3)SiO_2.nH_2O$.
Mahadevite, a mica.
Pennantite, $(Mn,Al)_6(Si,Al)_4O_{10}(OH)_8$.
Manganese-chlorite.
Nagolnite, $H_4Al_2SiO_7$.
Al-chamosite.
Chromamesite.
Němecite, $H_4Fe_2Si_2O_9.5H_2O$.
Neoglauconite.
Hanušite, $H_2Mg_2(SiO_3)_3.H_2O$.
Alumino-chrysotile.
Minnesotaite,
$(OH)_{5\cdot5}(Fe'',Mg)_{5\cdot5}(Si,Al,Fe''')_8O_{18\cdot5}$.
Jusite $(Ca,Na,K)_5(Si,Al)_6O_{10}.5H_2O$?
Ferrikaolinite.
Parakaolinite.
Daunialite, Si-montmorillonite.
Gumbrine, fuller's earth.

Hydrocarbons.

Chirvinskite.
Kladnoite, $C_6H_4(CO)_2NH$.
Rhabdopissite.
Titano-thucholite.
Velikhovite.

[1] Only selected names given in the preceding alphabetical list are here included.

MINERALOGICAL ABSTRACTS

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Notices of Books

ELLS (A. F.). *Structural inorganic chemistry.* Oxford (Clarendon Press), 1945, viii+590 pp., 4 pls., 172 text-figs. Price 25*s.*

This book, another excellent production from the Clarendon Press at a reasonable price, is intended to be complementary to the usual text-book of inorganic chemistry. The author assumes the knowledge of how a given substance is made and how it is converted into other substances. He is concerned with answering the questions 'what is it made of, what holds the constituent parts together, and how are they arranged?' The principal aim in view is a systematic presentation of inorganic chemistry so that the new knowledge of the solid state and description of crystal-structures are not merely added to descriptions of elements and compounds but incorporated as integral parts of the subject. The first part of the book is introductory, dealing with the structure of the atom, atomic forces, the principles underlying the crystalline state, and the experimental methods of structural chemistry. Sections on mixed crystals, laws of chemical combination, defect structures, isomorphism, and reactions in the solid state are particularly useful summaries. The second and larger part of the book contains the systematic structural treatment and reveals the lack of systematic study of many important groups of compounds, e.g. the phosphates. Although this gallant attempt lacks the elegance of the earlier books of Hassel and Evans [M.A. 7–311] on crystal chemistry, it will stimulate the research worker and show the general reader how rapidly the former barrier between physics and chemistry is disappearing. The book is well illustrated and those diagrams of crystal-structure redrawn by the author are noteworthy. A subject index and an index of chemical formulae are useful additions, but the list of 209 literature references arranged alphabetically under authors' names, without titles and not referred to directly in the text, is of doubtful value. F. A. B.

RANDENBERGER (E.). *Röntgenographisch-analytische Chemie. Möglichkeiten und Ergebnisse von Untersuchungen mit Röntgeninterferenzen in der Chemie.* Basel (Verlag Birkhäuser), 1945, 287 pp., 121 text-figs. Price 24.50 (bound 28.50) Swiss francs.

This year many books have been published on subjects more or less closely related to X-ray crystallography and studies of the solid state. Naturally not all of them cover exactly the same ground and the diversity of titles reflects ingenuity but not always originality. This volume is the second of the chemical series of text-books and monographs from Basel and a little less forbidding than its predecessor by P. Niggli [M.A. **9**–218]. Both are printed and bound in first-class style, but the illustrations of structure models and some of the X-ray photographs leave much to be desired. However, this book summarizes work of interest to the crystallographer and chemist after an introductory treatment of the X-ray methods of studying crystalline materials. Chapter 7, on the X-ray study of changes and reactions in the solid state, contains interesting accounts of work during the last decade, but chapter 8, on crystal-structure determinations, is too condensed to be intelligible. F. A. B.

Guinier (André). *Radiocristallographie.* Paris (Dunod), 1945, ix+294 p
16 pls., 156 text-figs. Price unbound 700 francs.

Between the identification of substances by X-ray powder photographs, wh
calls for no special aptitude, and the more difficult problems of crystal-structu
determinations lies a field of application of X-ray methods which is dealt wit
this book. It has been written primarily for technicians in industrial laborato
and the author has coined the new term radiocrystallography to distinguish t
applications of the diffraction of X-rays by crystals from radiography. He h
developed the theoretical basis of the technique in a thorough manner, his tre
ment of the reciprocal lattice and its application to specific problems be
particularly happy. The topics which will be of interest to the mineralogist an
petrographer are his study of crystalline texture (chapter 7), crystalline imper
tions (chapter 10), the diffraction of X-rays by amorphous substances (chapter
and the determination of submicroscopic particle-size by scattering at sm
angles (chapter 12). The quality of the paper used for this valuable additio
scientific literature looks surprisingly poor to those who have admired litera
work printed and published in Paris during the recent war. Most of the pla
however, do reflect the skill and high technical achievement attained in th
author's laboratory. F. A. B.

Zachariasen (William H.). *Theory of X-ray diffraction in crystals.* New Yo
(John Wiley & Sons), 1945, vii+255 pp., 30 figs. Price $4.00.

This book is based upon a lecture course for graduates of physics and chemistr
at Chicago University and is intended to give an adequate treatment of the theo
of space lattices and of X-ray diffraction in crystals. The contents are 'Th
nature of crystals', 'The symmetry of crystals', 'Theory of X-ray diffraction i
ideal crystals', 'X-ray interference in real crystals', with two appendices on tenso
(the author prefers the term dyadics) and group theory. The treatment through
out is formal and mathematical and a considerable fraction of the materi
presented represents the result of original researches. F. A. B.

[Boky (G. B.)] Боний (Г. Б.). Кристаллооптический анализ. [Crystallo-optica
analysis.] Инст. Общей и Неорган. Химии, Акад. Наук СССР [Inst. Genera
& Inorg. Chem., Acad. Sci. USSR], Moscow & Leningrad, 1944, no.
156 pp. Price 11 rub.

This first part tabulates data for 820 optically uniaxial inorganic and organi
substances, on much the same lines as the tables of Larsen and Berman [M.A
5–481]. Table I (nos. 1–358) includes the more completely determined substance
and table II (nos. 359–820) those for which no refractive indices (but in some case
the birefringence) have been determined. The data given include refractiv
indices, birefringence, crystal habit, cleavage, colour, specific gravity, hardness
and melting-point. L. J. S.

New Minerals

Kašpar (Jan Václav). *Hanušit, nový nerost.* [Hanušite, a new mineral.] Chem
Listy, Praha, 1942, vol. 36, no. 6, pp. 78–81, 3 figs. [M.A. **9**–6.]

Melaphyre (tholeiite) in the Želechovské valley near Libštát in NE. Bohemi
is penetrated by veinlets of pectolite which is altered to a minutely fibrou

wish mineral with the composition SiO_2 57·37, FeO 3·57, MnO 0·54, MgO , CaO 4·84, H_2O (+ 200°) 6·49, H_2O (−200°) 8·68 = 100·04. The dehydra- curve shows loss of water at 700° 8·73, at 800° 11·36, at 1000° 15·22 %. ula $H_2Mg_2(SiO_3)_3.H_2O$. Sp. gr. 2·166, H. $1\frac{1}{2}$, $n > 1{\cdot}505$, straight extinction, rge. F.S.

AR (Jan Václav). *Ondřejit, nový nerost.* [Ondřejite, a new mineral.] First preliminary note. Věda Přírodní, Praha, 1944, vol. 23, pp. 132–137, 2 figs.

usts and irregular concretions recently found on prismatic crystals of nite in the Zbrašov caves near Hranice in eastern Moravia consist of white erulent material, the homogeneity of which was proved by X-ray photo- s. Sp. gr. 2·217; analysis gave CO_2 43·50, SiO_2 6·57, FeO 0·46, MgO 18·34, 12·65, Na_2O 8·31, H_2O (60°) 2·17, H_2O (650°) 2·07 = 94·07. If this deficit sents water expelled at a still higher temperature, the mineral would belong e thaumasite group. F. S.

TYLEVA (E. E.). *Zirfesite—a new zirconium mineral of the zone of hypergenesis.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1945, p. 48, pp. 502–504, 1 fig.

rconium minerals hitherto known (31 in number) all occur in granitic and lic pegmatites. Zirfesite is from the weathered eudialyte-loparite vein at nepachk, Khibina tundra, Kola peninsula, and is an alteration product of alyte. It is a powdery, pale yellow, clay-like mineral with a minute flaky cture; n 1·620, isotropic. Analysis III by L. B. Tumilovich approaches a ula $(ZrO_2,Fe_2O_3)SiO_2.nH_2O$, analogous to that of allophane. The heating e shows an endothermal break at 135° (loss of water 20·96%) and a sharp hermal break at 700° (n then 1·720); all the water is lost at 300°. The mineral adily soluble in dilute HCl, and 'represents a coagulated mixture of Zr, Si Fe gels'.

	SiO_2.	TiO_2.	ZrO_2.	$(Nb,Ta)_2O_5$.	Rare-earths.	Al_2O_3.	Fe_2O_3.	FeO.
I.	49·43	1·51	15·30	—	0·52	—	—	5·01
II.	35·00	0·72	18·87	—	—	—	20·24	1·14
III.	21·27	0·96	30·47	2·40	2·12	1·63	14·27	nil

	MnO.	MgO.	CaO.	Na_2O.	K_2O.	Cl.	H_2O+.	H_2O-.	Total.
I.	0·28	—	12·29	13·30	—	1·66	1·05		100·35
II.	3·92	5·22	1·21	0·80	—	—	12·48		99·60
III.	0·24	0·57	0·14	trace	0·21	nil	9·66	16·17	100·11

nalysis I by I. D. Borneman of eudialyte from Lyavochorr; II by E. E. styleva of decomposed eudialyte from Mannepachk. L. J. S.

RTH (Tom. F. W.) & KVALHEIM (Aslak). *Christensenite, a solid solution of nepheline in tridymite.* Sci. Results of the Norwegian Antarctic Expeditions 1927–1928 et sqq. instituted and financed by Consul Lars Christensen, Norske Vidensk.-Akad. Oslo, 1944, no. 22, 9 pp., 1 fig.

tridymite-like mineral, with α 1·477–1·480, β 1·478–1·481, γ 1·481–1·484, ning 17% of a lava from Deception Island is shown by spectroscopic analysis ontain 5% nepheline which is regarded as being in solid solution in tridymite. name *christensenite* is proposed for the members of the solid solution series

tridymite–nepheline. On a heating stage a single inversion, indicated by a sud change in birefringence, was observed at 135°. Tridymite from Kra exhibited two inversions at 115° and about 150°, but results varied in diffe tests. W. C

Bayramgil (Orhan). *Mineralogische Untersuchung der Erzlagerstätte von Iş (Türkei) mit einem Kapitel über Aufbereitungsversuche.* Schweiz. Min. P Mitt., 1945, vol. 25, pp. 23–114, 7 pls., 6 text-figs.

The deposits occur in fault fissures and as metasomatic replacements in U Cretaceous limestones and marls with associated volcanic rocks (basalts, an sites, dacites, vitrophyre) on the mountain Işıkdağ, 80 km. NNW. of An After mispickel, the most abundant ore-mineral is *yenerite* [M.A. **9**–37], galena, blende, pyrite, chalcopyrite, and appreciable amounts of gold and s The gangue is calcite, quartz, earthy white tourmaline [M.A. **9**–55], &c. Fu details are now given for the new mineral yenerite, including microsc characters in reflected light, X-ray spacings, and chemical analysis (fig previously given after deducting 15½% insoluble and 5½% blende from anal totalling 98·44). Experiments on dressing the fine-grained ore met with success. L. J. S

Allen (Victor T.) & Fahey (Joseph J.). *Mansfieldite, a new aluminum arse and the mansfieldite-scorodite series.* Program & Abstracts, Min. Soc. Am 1945, 26th Annual Meeting, p. 7; Amer. Min., 1946, vol. 31, p. 189.

Cavities in Eocene kaolinitic clay from Hobart Butte, Lane Co., Oreg contain mansfieldite as white cellular masses associated with realgar, &c. Sp 3·031, H. 3½, α 1·622, β 1·624, γ 1·642, 2V small medium, positive; orthorhomb formula $Al_2O_3.As_2O_5.4H_2O$. The X-ray pattern is similar to that of scorodite. plot of refractive indices against Al_2O_3–Fe_2O_3 for mansfieldite, aluminous scoro (from Hobart Butte), and scorodite indicates an isomorphous series. L. J. S

Fisher (D. Jerome). *Bastinite, a new pegmatite phosphate.* Program & Abstra Min. Soc. Amer., 1945, 26th Annual Meeting, pp. 9–10; Amer. Min., 19 vol. 31, p. 192.

Tiny triclinic crystals of bastinite occur with sicklerite on fractured surfa of lithiophilite from Custer, South Dakota. They are nearly colourless, H α 1·649, β 1·655, γ 1·658, 2V 73°, negative, and consist of phosphate of lithi with some iron and manganese. [M.A. **9**–278.] L. J. S

Peacock (M. A.) & Thompson (R. M.). *Montbrayite, a new gold telluride.* Progr & Abstracts, Min. Soc. Amer., 1945, 26th Annual Meeting, p. 21; Am Min., 1946, vol. 31, p. 204.

The very brittle, tin-white, triclinic crystals have perfect cleavages ($1\bar{1}$ ($0\bar{1}1$), ($1\bar{1}1$); sp. gr. 9·94, H. 2½; a 12·08, b 13·43, c 10·78 Å., α 104° 30½′, β 97° 34 γ 107° 53½′. Analysis by Williams gave Te 49·80, Au 44·32, Bi 2·81, Pb 1· Sb 0·90, Ag 0·55, Fe trace = 99·99; deducting Bi_2Te_3 and PbTe, the unit contains $(Au,Sb,Ag)_{24}Te_{37}$, or nearly $12Au_2Te_3$. Occurs with gold, tellurbismu altaite, petzite, melonite, &c., in the Robb-Montbray mine, Montbray townsh Abitibi Co., Quebec. L. J. S

EDWARDS (A. B.). *Some ilmenite micro-structures and their interpretation.* Proc. Roy. Australasian Inst. Mining & Metall., 1938, new ser., no. 110, pp. 39–58, figs. 8 pls.

Some of the ilmenites from various localities in Australia when examined under the ore-microscope show lamellae due to unmixing of the solid solution. *Nunhematite* ('white ilmenite') occurs at Mount Monger, Western Australia, as well-formed rhombohedral crystals, and two analyses of material from South Australia gave 5·98 and 11·31 % TiO_2; the streak is dark brown to black. When more than about 10 % of TiO_2 is present lamellae of ilmenite separate out from the ferric solution. The unmixing of ilmenomagnetite is more complete, the magnetite between the ilmenite lamellae containing only 0·01 % TiO_2. Ilmenite and pyrophanite ($MnTiO_3$) form solid solutions which do not unmix. Ilmenite and rutile appear to be immiscible and to form a eutectic. L. J. S.

RAMDOHR (Paul). *Die Mineralien im System Cu_2S–CuS.* Zeits. Prakt. Geol., 1943, vol. 51, pp. 1–9, 5 figs.

The Cu_2S–CuS diagram of N. W. Buerger [M.A. **7**–482; **8**–254, 364] is considered in relation to the microscopical examination of copper ores. The original chalcocite of A. Breithaupt (1844) is a mixture of chalcosine and covelline, and this name has been applied by Buerger to cubic Cu_9S_5 (with a small excess of S over Cu_2S; cubic α–Cu_2S does not exist). The name *neodigenite* is now suggested for cubic Cu_9S_5, which has been detected microscopically in copper ores from several localities. Seven varieties of 'blue chalcosine' and four of 'white chalcosine' are distinguished microscopically, there being both isotropic and anisotropic varieties in both groups. They form complex lamellar (exsolution) intergrowths, and their use as geological thermometers is not practicable. L. J. S.

DE CREATTA (Ciro). *Studio petrografico di alcune argille montmorillonitiche pugliesi.* L'Industria Mineraria d'Italia e d'Oltremare, Faenza, April, 1943, no. 4, reprint 23 pp.

A bentonite-like clay occurring as bands in Miocene clayey limestone at Castelnovo della Daunia and other places near Lucera in Puglia consists mainly of montmorillonite ($\beta = \gamma$ 1·51–1·52, strong birefringence 2V small) with about 5 % of free silica (opal, chalcedony, quartz) of organic origin, and small amounts of sericite, chlorite, and kaolinite. Five analyses by A. M. Tomba gave SiO_2 62·62–63·72, TiO_2 0·13–0·87, Al_2O_3 13·75–16·34, Fe_2O_3 0·65–2·27, MgO 1·42–2·68, CaO 1·43–3·14, Na_2O 0·25–0·64, K_2O 0·19–0·37, H_2O+ 4·47–6·21, H_2O- 10·79–12·87 %. Molecular ratios $Al_2O_3 : SiO_2 : H_2O = 1 : 5·9–7·2 : 5·8–6·8$, corresponding to an excess of free silica of 19·26–27·32 % over the montmorillonite formula $Al_2O_3.4SiO_2.H_2O.n(Ca,Mg)O.mH_2O$. The name *daunialite* is suggested for a siliceous montmorillonite of sedimentary origin, as distinct from bentonite of volcanic origin. L. J. S.

HENSEL (P.). *Om sjögrenit som mineralnamn.* Geol. För. Förh. Stockholm, 1946, vol. 68, pp. 110–111. (Swedish with English abstract.)

A new variety of mineral from Cornwall' described by E. Kinch, F. H. Butler, and H. A. Miers in 1886 (Min. Mag. **7**–85) as differing chemically ($5Fe_2O_3.P_2O_5.8H_2O$) from dufrenite but probably orthorhombic, was determined by

J. S. Krenner (Compt. Rend. Internat. Geol. Congress, Stockholm, 1910, vo
p. 129) to be probably triclinic and was named by him sjögrenite. This
priority over the sjögrenite of C. Frondel, 1940 [M.A. 8–51, 99]. L. J.

Smith (W. Campbell), Bannister (F. A.), & Hey (Max H.). *Pennantite, a manganese-rich chlorite from Benallt mine, Rhiw, Carnarvonshire.* Min. 1946, vol. 27, pp. 217–220.

Topographical Mineralogy

Kratochvíl (Josef). *Topografická mineralogie Čech.—Topographische Mineralogie Böhmens.* Vol. 1, [xii pp.]+pp. 1–408 [Aag–Hory Stříbrné]. Archiv Přírodovědecký Výzkum Čech, 1937, vol. 19, no. 4.

—— —— Vol. 2, pp. 409–992 [Hory Stříbrné–Myštice]. German summ pp. 1–64. Ibid., 1938, vol. 20, no. 1.

—— —— Vol. 3, pp. 993–1394 [Mýtina–Říště]. Ibid., 1940, vol. 20, no. 4.

—— —— Vol. 4, pp. 1395–2014 [Saboř–Županovice]. Ibid., 1943, vol. 21, n

This great work, a labour of more than thirty years, gives complete and det information of the mineral occurrences in Bohemia, and also details of the hist of mining at each locality. The arrangement is alphabetical according localities, and a bibliography is given for each, e.g. Příbram 507, Jáchymov 4 Cínvald 315 items. The material is brought up to 1936, and supplements being prepared for later publication. Many data are here published for the f time, based on the National Museum and other collections and on informat supplied by local collectors. F. S

Kratochvíl (František). *Siderit od Eisendorfu a Eisensteinu.* [Chalybite fr Eisendorf and Eisenstein.] Zprávy Geologického Ústavu pro Čechy Moravu (= Věstník Státního Geol. Ústavu Československé Republi 1943, vol. 18 (for 1942), pp. 157–162. (With German abstract.)

Chalybite ore forming a band in mica-schist at Eisenstein (= Železná Ru SW. Bohemia) gave CO_2 33·26, Fe_2O_3 2·75, FeO 45·60, MnO 9·69, MgO 1· CaO 1·74, H_2O 0·60, insoluble 5·27 = 100·14. F. S

Kašpar (Jan Václav). *O krystalech fluoritu z Kosoře.* [On fluorite crystals fr Kosoř.] Věda Přírodní, Praha, 1940, vol. 20, pp. 82–83, 1 fig.

Fluorite, as violet cubes with good-reflecting faces (237) on the edges, occ with smoky quartz in the Upper Silurian limestone at Kosoř, SW. of Praha. F. S

Kašpar (Jan Václav). *Měď z melafyru od Lomnice nad Popelkou.* [Copper in melaphyre from Lomnice on Popelka.] Věda Přírodní, Praha, 1940, vol. pp. 257–259, 1 pl.

Melaphyre (tholeiite) from Lomnice, NE. Bohemia, contains veins of jasp and other forms of silica together with calcite and baryte. Native copper, dendritic forms and wire rimmed by cuprite, occurs in a jasper breccia consisti of fragments of green jasper cemented by grey jasper; and also in the tholei as specks consisting of an intimate mixture of copper and cuprite ('cuprocuprit or as pseudomorphs after plagioclase. F. S.

PAR (Jan Václav). *Pektolith ze Želechovského údolí u Libštátu.* [Pectolite from the Želechovské valley near Libštát.] Zprávy Geologického Ústavu pro Čechy a Moravu (= Věstník Státního Geol. Ústavu Československé Republiky), 1942, vol. 17 (for 1941), pp. 42–49, 1 fig. (With German abstract.)

ctolite from veins in tholeiite-melaphyre gave I for rose-coloured material II for white. Water is lost only between 750° and 900° C. The succession is lite—zeolites—calcite—secondary alteration products.

	SiO_2.	FeO.	MnO.	MgO.	CaO.	NaO.	K_2O.	H_2O.	Total.	Sp. gr.
I.	53·33	0·22	0·35	0·11	33·27	9·27	0·55	2·79	99·89	2·895
II.	52·70	0·20	0·49	0·65	34·14	8·25	0·29	3·50	100·22	2·864

F. S.

PAR (Jan Václav). *Vápencové povlaky na jezírkách ve Zbrašovských jeskyních.* Calcite crusts on small lakes in the caves of Zbrašov.] Věda Přírodní, Praha, 1943, vol. 22, pp. 130–136, 5 figs.

the Zbrašov caves near Hranice on Bečva in eastern Moravia the circulation aCO_3 is intensified by mofettes, and thin crusts of calcite ($02\bar{2}1$), containing s of Ba and Sr, cover the surface of small lakes. Colloidal iron oxide in less tity is anterior to the calcite. F. S.

ŤA (Tomáš). *Nález recentní síry a salmiaku v Kelčanech na Moravě.* [Recent find of sulphur and salammoniac at Kelčany in Moravia.] Věda Přírodní, Praha, 1944, vol. 23, p. 61.

ll the three modifications of native sulphur (determined by J. Sekanina A. 5–49, 145]) and crusts and groups of minute crystals of salammoniac have n found in the lignite mine of Kelčany near Kyjov in SE. Moravia; also nerous sulphates formed by the oxidation of marcasite. F. S.

INA (Jan). *Žíly s barytem u Bořkova u Semil.* [Veins with baryte at Bořkov near Semily, NE. Bohemia.] Věda Přírodní, Praha, 1942, vol. 21, pp. 212–213.

he succession of minerals is: quartz—baryte and pyrite—calcite ($21\bar{3}1$)—wad. Košov and Marcinov, near Lomnice, a second generation of quartz replaces te. F. S.

ÁČEK (Radim) [1905–42]. *Výskyt kobaltinu na Českomoravské vysočině.* [Occurrence of cobaltite in the Bohemo-Moravian highland.] Věda Přírodní, Praha, 1940, vol. 20, pp. 308–309, 1 fig.

obaltite, as masses of microscopic crystals (*a o e*) and irregular aggregates, has n found in a small skarn deposit with garnet and hedenbergite, near an old gnetite mine at Čachnov, west of Polička in eastern Bohemia. Partial analysis e S 9·69, As 21·00, Co 18·22, Ni trace, Fe 2·35, the remainder being silicates. s is the first indubitable record of the occurrence of cobaltite in Czechoakia. F. S.

Nováček (Radim) [1905–42]. *Slovenské rtuťové tetraedrity.* [Mercury t hedrites of Slovakia.] Zprávy Geologického Ústavu pro Čechy a M (= Věstník Státního Geol. Ústavu Československé Republiky), 1943, v (for 1942), pp. 107–110. (With German abstract.)

Mercurial tetrahedrites from the Slovakian Ore Mountains are either ri Hg (I–III) or much poorer (IV–V). Under VI crystals from Maškara in B The original schwazite from Schwaz in Tirol shows Hg only 1·10–1·75 %.

	Hg.	Ag.	Sp. g
I. Kotrbach, light grey	16·4%	0·09%	5·2
II. Rožňava, dark grey	17·2	0·104	5·1
III. Nižná Slaná, light grey	12·4	0·262	5·0
IV. Kotrbach, dark grey	6·2	0·047	4·7
V. Ružina, greyish-black	0·5	0·19	4·4
VI. Maškara, Bosnia	9·0	0·074	5·0

P

Rost (Rudolf) & Tučeк (Karel). *Manganokalcit z Příbramě.* [Manganoca from Příbram.] Rozpravy České Akad., 1944, vol. 54, no. 11, 17 pp., 2 text-figs.

Analysis of deep rose-red manganocalcite gave CO_2 43·33, CaO 50·99, MnO FeO 0·72, MgO 0·06, BaO and SrO nil = 100·30. Other partial analyses gave 1·67–6·54, FeO 0·58–2·74. The intensity of the fluorescence in ultra-violet is independent of the amounts of MnO and FeO.

ω.	ε.	Sp. gr.	$MnCO_3$.
1·6641	1·4918	2·728	2·65%
1·6688	1·4944	2·748	4·21
1·6755	1·5088	2·775	7·38

F.

Slavík (František). *Dva pyroxeny: světlý diallag a spodumen z vápenců Železn hor.* [Two pyroxenes: light diallage and spodumene from the limestone the Iron Mts.] Věda Přírodní, Praha, 1940, vol. 20, pp. 282–285, 1 fig.

In the group of limestone localities, Bojanov, Polánka, Dehetník, and N Mlýny (erroneously also Vápenný Podol), in Bohemia, two pyroxenes of alm identical external appearance have been described. One is a white or pale diallage with $\gamma : c = 39°$. Analysis of the spodumene by Kubricht in 1889 g (after deducting calcite) SiO_2 58·66, Al_2O_3 31·11, CaO 1·55, Na_2O 2·71, Li_2O 2 H_2O 3·46 = 100·00. Notwithstanding the cymatolitic alteration, the exte and optical characters are those of typical spodumene. F.

Quensel (Percy). *Minerals of the Varuträsk pegmatite. XXXVI. Further alt tion products of pollucite.* Geol. För. Förh. Stockholm, 1945, vol. 67, pp. 5 554, 1 fig. [Nos. XXXIII–XXXV, M.A. **9**–201.]

The alteration of pollucite to white kaolinite and a yellow clay previou described [M.A. **7**-335] is ascribed to surface weathering. New workings a depth of 20 metres show an alteration of the mineral in contact with pegma to a soft white kaolinite with sp. gr. 2·595, β 1·540, which gave analysis SiO_2 48 Al_2O_3 35·87, $Cs_2O < 0·1$, H_2O+ 13·13 %, &c. L. J. S

SEL (Percy). *Minerals of the Varuträsk pegmatite XXXVII. A spodumene-quartz symplektite.* Geol. För. Förh. Stockholm, 1946, vol. 68, pp. 47–50, figs.

ne specimens of spodumene show an intricate myrmekitic-perthitoid inter- h of 24 % of vermicular quartz, the *c*-axes of the two minerals being ated at right angles. [M.A. 7–120, 335.] L. J. S.

AD (Richard). *Jarosit fra Danmark.—Jarosite from Denmark.* Medd. Dansk. Geol. For., 1942, vol. 10, pp. 108–114. (With English summary.)

rojarosite from fissures in Eocene clay at Refsnæs has the form of minute rhombohedra with ϵ 1·69, ω 1·78, sp. gr. 3·06. Analysis by A. H. Nielsen, 2·65, Fe_2O_3 46·73, Na_2O 4·97, K_2O 1·97, H_2O 13·68 = 100·00, agrees with $)Fe_3(OH)_6(SO_4)_2.H_2O$. Jarosite (K and Na not analysed) also occurs with m and celestine in Eocene rocks at Helgenæs and Mors, and as a yellow scence on the Cambrian alum-shales of Bornholm. L. J. S.

EAN (André). *Sur les occurrences de millérite dans le Carbonifère de la Belgique.* Bull. Soc. Belge Géol. Bruxelles, 1943, vol. 52, pp. 34–50.

ist is given of 33 occurrences of millerite in the coal basins of Liége, Hainaut, ampine, the majority of them in the last. Most are in crevices and geodes in edimentary rocks. L. J. S.

DIG (E.) & QUERVAIN (F. de). *Fundstellen mineralischer Rohstoffe in der Schweiz.* Bern (Geotech. Komm.), 1941, ix+189 pp., map (1 : 600,000), 3 pls.

account of Swiss occurrences of economic minerals grouped under: coals, nen, gas (pp. 1–96), ores and ore deposits (pp. 97–147), other useful minerals 148–169). There is a good index of localities in addition to a subject-index. L. J. S.

DLAENDER (Carl). *Über den Erythrin von Mont-Chemin (Wallis).* Verhand. Schweiz. Naturfor. Gesell., 1942, session 122, p. 112.

ythrite as radial or reniform aggregates and scales, forming an efflorescence abandoned mine, gave α 1·622, β 1·660, γ 1·681, $\gamma : c = 31–32°$; pleochroism, e rose almost colourless, β pale violet-rose, γ deep rose. L. J. S.

ELEV (A. I.)] Киселев (А. И.). Минералогия Халиловских месторождений хромшпинелидов, магнезиальных карбонатов и никелевых руд на Ю. Урале. —KISSELEV (A. I.). *Mineralogie der Chalilowski Lagerstätten Chromspineliden, Magnesia Karbonaten und Nickel Erz am S. Ural.* Записки Ленинградского Горн. Инст. (Annales Inst. Mines Leningrad), 1938, vol. 11 (for 1937), pp. 1–59 (Russian), 59–60 (German summary), 37 figs.

ie Khalilovo massif, 60 km. west of Orsk in the southern Urals, is a complex bbro with peridotite, harzburgite, dunite, and other ultrabasic rocks, largely ntinized. Economic deposits of chrome-spinel (22–58 % Cr_2O_3) occur as s throughout the dunite, while nickel-bearing sulphides (pyrrhotine, pent- ite, millerite, &c.) form disseminations in the peridotite. Sixty-nine minerals ineraloids are recorded from the deposit, mostly from a pre-Jurassic zone of hering. These include the carbonates hydromagnesite (earthy, α 1·524, 28, γ 1·544, 2V medium, negative), artinite (white radiating needles, α 1·523,

β 1·527, γ 1·540), brugnatellite (golden-brown, hexagonal scaly aggregates, c... 'constants' variable according to iron content, β 1·565–1·605), and z... (colloidal, deep-green, composition approximately $NiCO_3.Ni(OH)_2.3H_2O$). ... the hydrous silicates cerolite (granular and earthy, cream-coloured, n ... 1·535), nickeliferous 'cerolite-garnierite' (compact, opaline apple-green, n ... 1·560), garnierite (cryptocrystalline and colloidal, emerald-green, n 1·596–... revdinskite (fibrous, apple-green, β 1·558–1·560), and volkonskoite (bluish-y... n 1·520–1·546, 2V very small). Chemical analyses of these minerals are give... their paragenesis is discussed. [M.A. **8**–331.] C. F.

Pulfrey (William). *Geological survey of eastern Maramma and adjoining ... western Kakamega, northern Kavirondo.* Colony and Protectorate of K... Mining and Geol. Dept., Report no. 8, 1945, 38 pp., 6 figs. (maps). Pr...

The report describes the gold occurrences of the district and gives recomm... tions for prospecting. Igneous rocks described include rhyolites, basalts, an... in the pre-Cambrian. Granite and associated minor intrusives occupy ext... areas north and south of the sedimentary and volcanic rocks and the prese... a well-zoned contact metamorphism gives evidence of the subterranean su... of the plutonic intrusions. The metamorphosed rocks include chiastolite-... stones and phyllites and cordierite-bearing types. W. C.

Carroll (Dorothy). *Census of Western Australian minerals.* Mineral Resou... of Western Australia, Dept. of Mines, 1945, Bull. no. 1, 72 pp., 1 fig. (m...

Alphabetical list of 363 species and varieties giving the chemical formulae ... localities where found. L. J.

Hutton (C. Osborne) & Seelye (F. T.). *Contributions to the mineralogy of ... Zealand—Part I.* Trans. Roy. Soc. New Zealand, 1945, vol. 75, pp. 160–...

Muscovite as large books from granite-pegmatite; (I) from Henry pass, Ge... Sound, $(OH)_{2\cdot35}(Mg,Fe'',Fe''',Ti,Al)_{1\cdot94}[(Si,Al)_4O_{10}](Ba,K,Na)_{0\cdot95}$; (II) from M... ner's peak, south Westland, $(OH,F)_{2\cdot43}(Mg,Fe'',Fe''',Ti,Al)_{1\cdot89}[(Si,Al)_4O_{10}](... K)_{0\cdot96}$. Corundophilite (III) from dravite-chlorite-rock from Aorere, Nels... $(OH)_{7\cdot64}(Mg,Fe'',Ti,Al)_{6\cdot07}[(Si,Al)_4O_{10}]$. Dravite (IV) as large (6-inch) pri... from Aorere, Nelson, $(Na_{1\cdot85},Ca_{0\cdot84})(Mg_{6\cdot89},Fe''_{1\cdot49},Fe'''_{0\cdot78},Ti_{0\cdot29},Al_{17\cdot72})$... $Si_{18}H_{10\cdot57}O_{93}$. Beryl (V) as coarse-columnar, pale-green crystals 5 inches ac... from Charleston, $(Be,Na)_{2\cdot91}(Mg,Fe'',Fe''',Al)_{2\cdot1}Si_6O_{18}$.

	SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	MgO.	CaO.	Na_2O.	K_2O.	H_2O+.	H_2O-
I.	44·73	0·34	30·67	3·42	1·42	0·02	1·56	nil	0·53	10·18	5·17	1·42
II.	45·50	0·20	33·20	1·03	1·41	0·04	0·96	trace	0·52	10·49	5·37	1·10
III.	27·64	0·22	22·48	0·06	12·06	0·025	24·32	nil	0·17	0·06	11·45	1·80
IV.	36·07	0·84	30·43	2·17	3·62	trace	9·33	1·60	1·91	0·06	3·20	0·20
V.	65·14	0·06	18·20	0·65	0·28	trace	0·50	trace	0·40	0·05	1·98	0·23

	P_2O_5.	Cr_2O_3.	V_2O_3.	BaO.	F.	S.	Total.	Sp. gr.	α.	β.	γ.	2V
I.	0·03	nil	0·02	0·66	0·02	0·03	100·23	—	1·567	1·604	1·609	39
II.	0·05	nil	nil	0·04	0·18	0·03	100·12	—	1·560	1·595	1·599	38
III.	—	—	0·06	—	—	—	100·34	2·80	1·600	1·600	1·606	0–8
IV.	—	0·07	—	—	0·08	—	99·95	3·25	1·627	—	1·655	—
V.	—	—	—	—	—	—	100·31	2·70	1·572	—	1·577	—

III, also NiO trace. IV, also B_2O_3 10·35, SrO 0·02. V, also BeO 12·82.

L. J. S.

OMSON (Jas. E.). *Mineral occurrences in the north Hastings area.* Ontario Dept. Mines Annual Report, 1943, vol. 52, pt. 3, iv+80 pp., many unnumbered figs. + geol. map (1 : 126,720).

The northern part of Hastings county, Ontario, has in the past yielded commercial corundum, graphite, felspar, mica, sodalite, magnetite, molybdenite, gneiss, and gold. Recent operations have been largely confined to the quarrying of nepheline-syenite for ceramic use. The various mineral occurrences are described, and a new map of the nepheline-syenite area east of Bancroft is reproduced. The nepheline-syenites are distinctly foliated, conformable in attitude with the surrounding paragneisses from which they may have been formed by metasomatic replacement, and of earlier date than the associated massive granite and normal syenite. There is no evidence of their formation by limestone assimilation. [M.A. **8**–322.] C. F. D.

EDIN (G. C. *Jr.*) & THURSTON (W. R.). *Celestite from Livingstone County, Kentucky.* Amer. Min., 1945, vol. 30, pp. 639–640.

Tabular crystals (2 cm.) of pale sky-blue celestine, not before recorded from the Kentucky–Illinois fluorite region, occur in a stringer in a calcite vein giving place to fluorite in depth; 2V 51°, α 1·622, β 1·624, γ 1·630. L. J. S.

COKE (S. R. B.) & PERRY (Eugene S.). *Columbium and cerium minerals in Montana.* Amer. Min., 1945, vol. 30, pp. 623–628.

Widely scattered pegmatites contain small amounts of black minerals for which optical data, sp. gr., and spectrographic analyses are given. Those from pre-Cambrian pegmatites are placed in the fergusonite group and contain relatively high amounts of scandium. Others rich in cerium and of Cretaceous age are believed to belong to the allanite group. L. J. S.

DUDEY (Hatfield). *Dihydrite from Mineral County, Nevada.* Amer. Min., 1945, vol. 30, p. 640.

Dihydrite [? pseudomalachite] occurs as emerald-green to blackish-green, minutely botryoidal crusts at Calavada mine. Microchemical tests showed Cu, P_2O_5, and a little As_2O_5; n 1·76. L. J. S.

ACKLER (William C.). *Occurrence of nemalite in Alaska.* Amer. Min., 1945, vol. 30, pp. 640–641.

Aggregates of brittle hair-like fibres (8–9 inches long) occur with chrysotile serpentine on Shungnak river and Cosmos creek. 2V 30°(−70°), positive, ($\parallel$ fibre) 1·565, β 1·571, γ 1·584. L. J. S.

ØGVAD (Richard). *Magnetkis fra Ivigtut.—Pyrrhotite from Ivigtut, Greenland.* Medd. Dansk Geol. For., 1942, vol. 10, pp. 115–118, 1 fig. (With English summary.)

Only one small specimen is known. Under the ore-microscope pyrrhotine seen in small amount associated with chalcopyrite, galena, blende, and pyrite the cryolite. L. J. S.

Davey (John C.). *Venezuela—Land of mining opportunity.* Mining Mag. Lond. 1945, vol. 73, pp. 9–25, 2 figs. (maps).

—— *Venezuela—The Guayana highlands.* Ibid., pp. 137–151, 7 figs.

—— *Venezuela—The Guayana highlands. Gold deposits of the state of Bolu* Ibid., pp. 275–282, 338–343, 3 figs.

—— *Venezuela—The Guayana highlands. Diamondiferous alluvials of the sta e Bolivar.* Ibid., 1946, vol. 74, pp. 9–26, 11 figs.

A series of articles giving descriptions of the country and conditions, with sp reference to the geology and mineral deposits. Besides oil, bitumen, gold, iron ores, there are workable deposits of copper and mercury ores, magne phosphates, trona, mica, &c. Diamond is found along the Cavoni, Para Cuyuni, Mazaruni, and Kamarán rivers, near the British Guiana boundary. estimated total production during the period 1912–44 is 140,000 carats. largest stone, 'El Libertado', weighed 155 carats. L. J. S.

Rock-forming Minerals and Petrology

Tertsch (H.). *Zur Hochtemperaturoptik basischer Plagioklase.* Min. Petr. M (Tschermak), 1942, vol. 54, pp. 193–217, 9 figs.

—— *Zur Bestimmung von Hochtemperatur-Plagioklasen in Achsenschnitten.* Ib pp. 218–224, 1 fig.

The optical orientation of synthetic plagioclases containing 90, 80, and 70 An was determined on the universal stage. Curves show the deviations fro previous determinations, and the cause of the differences is discussed [M. 8–313]. Various natural high-temperature plagioclases were determined in axi sections by the method of E. Marchet [M.A. 3–39]. L. J. S.

Oftedahl (Christoffer). *High temperature optics in plagioclases of the Oslo regio* Norsk Geol. Tidsskrift, 1945, vol. 24 (for 1944), pp. 75–78, 1 fig.

The optical orientation of plagioclase phenocrysts from rhomb-porphyry an from akerite-porphyry agree better with high-temperature plagioclase than wit low-temperature plagioclase [M.A. 8–313]. L. J. S.

Naidu (P. R. J.). *Biaxial silica in pleonaste-bearing peridotites from Mysore.* Quar Journ. Geol. Mining Metall. Soc. India, 1944, vol. 16, pp. 139–140, 2 pls.

Peridotite from Chattanhalli, consisting of olivine, hypersthene, green pleonast (10·4 % of the rock), iron-ore, a colourless chlorite, and some calcite, contain interstitial patches of silica [? quartz] with 2V 15°, positive. The biaxial characte is attributed to metamorphism of the rock. The rapid crystallization of Mg-spin and iron-rich olivine is supposed to have left a residuum of silica. L. J. S.

Hallimond (A. F.). *On the graphical representation of the calciferous amphibole* Amer. Min., 1943, vol. 28, pp. 65–89, 3 figs.

Selected chemical analyses (196) from the literature are plotted on a parti triangular diagram with $Ca_2Mg_5Si_3O_{22}(OH)_2$ (tremolite), $Ca_2Mg_3Al_4Si_6O_{22}(OH$ ('Tschermak molecule'), and $Ca_2Na_2Mg_5Al_2Si_6O_{22}(OH)_2$ at the corners, wit $Ca_2NaMg_4Al_3Si_6O_{22}(OH)_2$ midway between the last two, representing replac ments of Al_4 for Mg_2Si_2 and of Na_2Al_2 for Si_2. The number of silicon atoms i

unit cell is plotted along one edge and the number of alkali atoms allotted ne 'vacant space' along an adjoining edge. Areas of the parent-rocks (lime- e, schist, and amphibolite, diorite, basalt, and nepheline-syenite) are marked

L. J. S.

CHELL (A. N.). *Variations in composition and properties of the calciferous amphiboles.* Amer. Min., 1945, vol. 30, pp. 27–50, 12 figs.

lected chemical analyses (104) are plotted on a partial triangular diagram $Ca_2Mg_5Si_8O_{22}(OH)_2$ (tremolite) and $Ca_2Mg_3Al_4Si_6O_{22}(OH)_2$ (tschermakite) at corners, and $NaCa_2Mg_4Al_3Si_6O_{22}(OH)_2$ and $NaCa_2Mg_5AlSi_7O_{22}(OH)_2$ at the le of two sides. The plots are continued inside a partial triangular prism at ther end of which are the corresponding iron compounds $Ca_2Fe_5Si_8O_{22}(OH)_2$ tremolite), $Ca_2Fe''_3Fe'''_2Al_2Si_6O_{22}(OH)_2$ (ferrotschermakite), $NaCa_2Fe''_4Fe'''$ $_6O_{22}(OH)_2$, and $NaCa_2Fe_5AlSi_7O_{22}(OH)_2$. Further plots of this prism and on surfaces give the approximate relations of sp. gr. γ, $\gamma-\alpha$, $\gamma : c$, and 2V. her series of 18 analyses of oxyhornblendes is dealt with in a similar manner, nd-members of heated material being $Ca_2Fe''_3Fe'''_2Si_8O_{24}$, $Ca_2Fe''Fe'''_4Al_2$ $_{24}$, $NaCa_2Fe''_2Fe'''_3Al_2Si_6O_{24}$, and $NaCa_2Fe''_3Fe'''_2AlSi_7O_{22}$. [M.A. **5**–216.]

L. J. S.

LIE (Steinar). *Hastingsites, and amphiboles from the epidote-amphibolite facies.* Norsk Geol. Tidsskrift, 1945, vol. 25, pp. 74–98, 2 figs.

he composition of amphiboles is calculated from micrometric measurements chemical analyses of the parent-rocks, and mg = mol.MgO/(mol.$2Fe_2O_3$+FeO+)+MgO) is plotted against the mean refractive index $(\alpha+\beta+\gamma)/3$. Al acing Si is also plotted against Al replacing Mg. Black crystals (1 cm.) of hastingsite from the granite at Tysfjord, northern Norway, have α 1·694, 7105, γ 1·712, $\gamma : c = 17\frac{1}{2}°$, and gave analysis by M. Klüver (after deducting quartz, 1 % lepidomelane, and 0·13 % pyrrhotine) SiO_2 38·89, TiO_2 0·65, $_3$ 11·88, Fe_2O_3 7·56, FeO 21·88, MnO 0·66, MgO 2·68, CaO 10·66, Na_2O 1·75, 1·99, F 0·21, $H_2O+1·19$ = 100·00, sp. gr. 3·390; its relation to hastingsite n other localities is discussed.

L. J. S.

DIUS (Nils). *On the substitution relations in the amphibole group.* Årsbok Sveriges Geol. Unders., 1944, vol. 38, no. 2 (Avh. Upps., ser. C, no. 460), 11 pp., 4 figs.

he extensive substitution ranges suggested by B. E. Warren [M.A. **4**–201, 278] criticized. 'The whole amphibole group comprises several isomorphic series ch are separated by areas of unmixing.' The series distinguished are antho- llite–gedrite, cummingtonite–grunerite, tremolite–actinolite, hornblendes gasite–hastingsite), and alkali–amphiboles. The fields of these are marked on triangular diagrams. Sub-types of the lattice structure of these amphi- s are suggested to be sufficiently different to preclude the transition of one another. [M.A. **4**–528; **5**–64, 118.]

L. J. S.

DIUS (N.). *The position of the richterite in the amphibole group.* Geol. För. Förh. Stockholm, 1945, vol. 67, pp. 266–270.

ew analyses (I by R. Blix, II by A. Bygdén) of richterite from Långban, den, together with earlier analyses, lead to the formula $H_2Na_2CaMg_5Si_8O_{24}$,

like that of tremolite with Na_2 in place of Ca, and similar to the relation betw... actinolite and arfvedsonite; there is, however, usually less than Na_2.

	SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	MgO.	BaO.	CaO.	Na_2O.	K_2O.
I.	53·80	0·10	1·37	1·89	0·00	8·69	18·45	0·30	5·43	5·63	1·72
II.	57·74	trace	0·37	0·29	trace	2·40	23·67	—	9·01	3·14	0·64

	F.	Cl.	SO_3.	H_2O.	Total.	Sp. gr.	α.	β.	γ.	$c:\gamma$.	$2V_\alpha$.
I.	0·36	0·04	0·19	1·91	99·88	3·08	1·622	1·635	1·641	19°	66° 3...
II.	0·37	—	—	2·39	100·02	2·99	1·605	—	1·627	17	mediu...

L. J. S...

Ray (S.) & Roy (S. K.). *Inclined extinction in Indian hypersthenes.* Q... Journ. Geol. Mining Metall. Soc. India, 1944, vol. 16, pp. 132–137, 1 f...

Six specimens of hypersthene from charnockites and other rocks, describe... previous authors as having extinction-angles up to 21°, when orientated on... universal stage all gave straight extinction in the planes $\alpha\gamma$ and $\beta\gamma$. All hav... optic axial plane parallel to (010), and pleochroism α pink, β yellow, γ blu... green. Inclined extinctions are given in sections that are not parallel to... prism zone. L. J. S...

Hutton (C. Osborne). *Some igneous rocks from the New Plymouth area.* Tra... Roy. Soc. New Zealand, 1944, vol. 74, pp. 125–153, 2 pls., 4 text-figs.

Petrographical descriptions with chemical analyses are given of porphyrite a... dacite occurring as cone-sheets with a dip of 40–50°. The twin-axes of the plag... clase do not fall on the Nikitin curves, suggesting the high-temperature for... Cristobalite (n 1·485) occurs in small patches. Anhydrite (α 1·573, β 1·5... γ 1·618, 2V 36°) as minute crystals in porphyrite. Analyses by F. T. Seel... I, greenish-brown hornblende from porphyrite; II, greenish-brown hornble... from dacite; III, diopside from porphyrite; IV, leonhardite from porphyr... differing from laumontite in its low water content.

	SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	MgO.	CaO.	Na_2O.	K_2O.	V_2O_3.	Cr...
I.	41·11	1·95	13·39	4·94	9·89	0·30	11·63	11·81	2·29	0·68	0·06	0·0...
II.	41·96	2·00	12·15	6·98	9·75	0·44	10·36	11·29	1·98	0·80	0·06	0·0...
III.	49·90	0·92	3·18	3·10	7·65	0·58	11·77	21·87	0·71	0·15	—	—...
IV.	54·10	0·11	20·44	1·70	—	0·05	0·45	8·65	2·60	0·55	—	—...

	BaO.	SrO.	F.	H_2O+.	H_2O-.	Total.	α.	β.	γ.	2V.	$\gamma:c$.	Sp....
I.	0·02	0·03	0·10	2·05	0·03	100·29	1·666	1·680	1·687	15–17°	70–78°	3...
II.	0·02	0·02	0·12	2·04	0·11	100·09	1·670	1·684	1·695	10–12	64–74	3·...
III.	—	—	—	0·45	0·20	100·48	1·684	1·691	1·710	56	44°	3·...
IV.	—	—	—	9·32	2·13	100·10	1·502	1·512	1·514	35–38	—	2·...

L. J. S...

Bennett (J. A. E.). *Some occurrences of leucite in East Lothian.* Trans. Edinbur... Geol. Soc., 1945, vol. 14, pp. 34–52, 2 pls., 2 text-figs.

Analcime pseudomorphs after leucite showing characteristic inclusions a... recorded in kulaite lava from The Lecks, North Berwick, comparable with t... leucite-kulaite of Blaikie Heugh, Haddingtonshire, described by E. B. Bailey... 1910. Other records are in blocks of leucite-basanite in agglomerate at The Lec... and in a leucite-melabasanite (Johannsen) from near Garvald, Haddington.

lcime-basanite at Kidlaw there are leucite-like structures which are thought e either resorbed leucite or primary analcime. Dark inclusions in the Traprain v phonolite contain spots which are compared with the pseudoleucites from ansas. [M.A. 7–39.] W. C. S.

DER (Rex T.). *Sapphirine from Dangin, Western Australia.* Geol. Mag. Hertford, 1945, vol. 82, pp. 49–54, 1 fig.

Sapphirine forms 4·5 % of a sapphirine-biotite-felspar-schist, and also occurs felspar lenses in biotite-schist, at Dangin, 90 miles east of Perth. It has sp. gr. 94, β 1·720, weak birefringence, 2V about 50°, negative; strong pleochroism, ale yellowish-green, β blue, γ deep-blue. Analysis by J. D. Hayton gave (after ducting 1·68 % enclosed limonite) SiO_2 15·26, TiO_2 0·04, P_2O_5 0·10, Al_2O_3 61·93, 6·61, MnO 0·21, MgO 15·61, Na_2O 0·22, K_2O 0·02 = 100·00; $(Mg,Fe)_2Al_4SiO_{10}$. e sapphirine has perhaps been derived from pleonaste present in hypersthenite oliths in granite from which the schists were derived. L. J. S.

NDIUS (N.). *Über die Bildungsbedingungen der Alkali-Titan- und Alkali-Zirkon-Silikate.* Geol. För. Förh. Stockholm, 1945, vol. 67, pp. 271–272.

The high melting-point (1825°) of TiO_2 is much lowered in the system Na_2O–O_2–SiO_2, with equal molecular proportions down to 550–600°. This explains e occurrence of alkali titano-silicates (e.g. ramsayite) in nepheline-syenite. In s alkalic rocks rutile has no doubt been formed from TiF_4 or $TiCl_4$. Similar ults obtain in the system Na_2O–ZrO_2–SiO_2. L. J. S.

AMBERG (H.). *Petrological significance of sub-solidus phase transitions in mixed crystals.* Norsk Geol. Tidsskrift, 1945, vol. 22 (for 1944), pp. 42–74, 15 figs.

The phase transitions of mixed crystals in the solid state are discussed from a ysico-chemical point of view with pressure-temperature diagrams. In the tectic type of transition only one component of the mixed crystal undergoes a ange; this may be a change in modification (e.g. epidote-plagioclase and talc-thophyllite equilibria), a change with decomposition (talc, calcite-actinolite), a change with reaction products (biotite, felspar-garnet). In the isodimorphic pe the two components may undergo these changes (orthohypersthene-nohypersthene, orthohypersthene-anthophyllite, chlorite-garnet, garnet-rdierite, actinolite-diopside, phlogopite-calcite (microcline), and hypersthene-geonite equilibria). These changes may give some indications of the condi-ns of pressure and temperature in regional metamorphism in the transition cies: green-schist $\rightleftharpoons$ epidote-amphibolite, epidote-amphibolite $\rightleftharpoons$ amphibolite, mphibolite $\rightleftharpoons$ granulite, and sanidinite $\rightleftharpoons$ hornfels. L. J. S.

AMBERG (Hans). *The thermodynamics of the earth's crust. I. Preliminary survey of the principal forces and reactions in the solid crust.* Norsk Geol. Tidsskrift, 1945, vol. 22 (for 1944), pp. 98–111.

—— *Note on the metamorphic differentiation of solid rocks.* Ibid., p. 115.

The influences of primary differences in pressure, temperature, and chemical mposition and of the size of mineral units are considered, and eventualities are scussed. The term 'petroblastic' is applied to those rocks with structures nilar to magmatic rocks which may be formed in the solid state by the migra-ns of atoms. L. J. S.

Rankama (Kalervo). *On the composition of the residue from silica in rock-analy*
Compt. Rend. Soc. Géol. Finlande, 1939, no. 14 (Bull. Comm. Géol. Finlan
no. 126), pp. 1–35, 3 figs.

The residue (0·43–1·50 % of the rock) after volatilizing the silica separat
with HF + H_2SO_4 was examined spectroscopically, and the amounts fo
compared with those for 16 Finnish igneous rocks of which detailed chem
analyses (SiO_2 41·19–75·48 %) are given. Estimates are given of the amount
Be, Zn, Ga, Ge, Sn, Pb, V, Cr, Mo, W, Co, Ni; in addition, the residues a
contain rare-earths (La, Ce, Yt, Sm), Al, Ba, Ca, Fe, K, Mg, Mn, Na, Sr, Ti, Z
Some of these, especially Ge, Sn, Pb, Ti, Zr, show an enrichment in the resi
compared with the rock, while there is none for rare-earths, W, Co, Ba, Ca, F
Na, Sr. The causes of the presence of these impurities in the silica residues a
discussed from a geochemical point of view. L. J. S

Feniak (Michael W.). *Grain sizes and shapes of various minerals in igneous ro*
Amer. Min., 1944, vol. 29, pp. 415–421, 1 fig.

The length and breadth of grains of the various minerals were measured i
sections of 200 plutonic rocks and the average areas and shapes tabulated an
shown diagrammatically for acid, medium, and basic rocks. L. J. S.

Lacroix (Alfred). *Les glaucophanites de la Nouvelle-Calédonie et les roches qui l*
accompagnent, leur composition et leur genèse. Mém. Acad. Sci. Inst. France
1942, vol. 65 (for 1941), 103 pp., 4 pls.

Glaucophanites and hornblendic amphibolites in New Caledonia and the schist
(mica-, talc-, and chlorite-schists and quartzites) in which they occur, hav
resulted from general metamorphism, related to tectonic movements, of dolerite
and gabbros intrusive in the sedimentary rocks. Paradolerites carry lawsonite
aegirine, and albite, and metadolerites carry pumpellyite. Glaucophane appear
in some paradolerites, and under more intense conditions of metamorphism
the transformation to glaucophanites and hornblendic amphibolites has been
completed. Some of the glaucophanites carry muscovite and garnet, and both
garnet and epidote occur in the amphibolites. Rocks derived from peridotite
(earlier in age than the dolerites) are serpentines and talc-schists; a chromite
rock (chromitite) carrying 39·65 % Cr_2O_3 is also recorded. The chemical and
mineral transformations involved are traced utilizing magmatic parameters
calculated from the 38 new analyses of rocks and minerals. Comparisons are
drawn with rocks from other areas: Aveyron (France), Madagascar, Basses
Pyrénées, and Corsica. Descriptions are given in the opening chapter of the mos
important minerals of these rocks. Analyses are given of glaucophane, crossite,
sodic hornblende (I) and an almandine (II). The sodic hornblende has sp. gr
3·115, 2V 80°, γ-α = 0·023, extinction-angle on (010) about 19°; pleochroism
α yellowish or colourless, β yellowish-green, γ bluish-green; it may be near
the barroisite of Murgoci (1922). The garnet is orange-coloured with a red tinge
sp. gr. 4·018.

	SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	MgO.	CaO.	Na_2O.	K_2O.	H_2O+	Total
I.	49·86	0·40	9·71	2·57	9·44	0·11	13·97	9·46	3·09	0·40	1·10	100·11
II.	37·48	1·22	20·49	0·98	26·36	1·61	4·11	8·06	—	—	0·14	100·45

The excellent plates include good photomicrographs of lawsonite and pumpelle. The rocks described are derived from numerous collections dating from t made by Garnier in 1867 to the most recent collection made by E. Aubert la Rüe in 1936. W. C. S.

CROIX (Alfred). *Les péridotites de la Nouvelle-Calédonie, leurs serpentines et leurs gîtes de nickel et de cobalt, les gabbros qui les accompagnent.* Mém. Acad. Sci. Inst. France, 1943, vol. 66 (for 1942), 143 pp., 13 pls., 7 text-figs.

Intrusive peridotites of Tertiary age and their associated serpentines occupy proximately a third of the area of New Caledonia. They are the source of portant deposits of nickel, cobalt, and chromium. The peridotites comprise lites, harzburgites, with occasional types referable to bronzitite and websterite. omite, a constant constituent of the peridotites, forms lenticular masses of omitite sometimes containing bronzite, diopside, and anorthite. The associated pentines are described and the hypotheses which have been advanced to lain serpentinization are considered. Serpentinization must have taken place ween the zone of weathering and the upper levels of the 'epi'-zone of metarphism, and the serpentinizing solutions were probably derived partly from erficial water and partly from subterranean sources. The nickeliferous ores derived from the peridotites and, to a less degree, from the serpentines by athering in the moist, warm climate which prevails. The process and the riety of ores are admirably described. The rather confused nomenclature of the keliferous silicates, to which the names noumeite, garnierite, and nepouite have en given, is discussed. It is suggested that garnierite should be retained only a name for nickel ore, and noumeite adopted as the name of the mineral species. her minerals described are deweylite (gymnite); sepiolite, sometimes nickelious; magnesite, found only at lower levels, below the nickeliferous zone; and somite. The red earth, a residual deposit, includes blocks of iron ores, chromite, d cobalt ore (asbolite), and masses of gibbsite. Dikes of felspathic rocks companying the peridotites are described. They include anorthitite, euphotide, enite, and diopsidite (with 5 new analyses). Special attention is given to the uctural deformation suffered by some of the gabbroic rocks resulting in portant mineral transformations, pyroxene being made over to hornblende, t without compositional change of the felspar. Considerable interest attaches the discovery of kaolin derived indirectly from the calcic plagioclase, the ermediate stage of alteration being faroelite. Finally, axe-heads and beads ed by the natives of New Caledonia are described. Axe-heads have been made nephrite, and also of some varieties of ouenite from Ouen Island. The source of e nephrite has not been found. No axe-heads of serpentine have been met with the collections examined, though serpentine as well as nephrite and ouenite has en used for beads. In conclusion, some remarks on jadeite are offered sumarizing the author's 1930 memoir on Burma jadeites [M.A. 5–71]. W. C. S.

OLTEDAHL (Olaf). *Studies on the igneous rock complex of the Oslo region. I. Some structural features of the district near Oslo.* Skrifter Norske Videnskaps-Akad. Oslo, I.Mat.-Naturv. Kl., 1943, no. 2 (for 1943), 71 pp., 39 figs., 1 map.

Descriptions are given of the field relations of the igneous rocks of the Oslo strict. Important conclusions are reached as to their modes of emplacement

and comparisons are drawn between the 'curve systems' in the Oslo region wi[th] the more perfect ring structures of Glen Coe and the Scottish Tertiary volca[nic] centres. The origin of volcanic breccias, some of which occur in pipe-like bo[dies] cut by numerous dikes or sheets, is also discussed. The illustrations include ma[ny] good photographs of hand-specimens of the rocks. Twenty-two analyses [are] given of porphyries, breccias, and some of the plutonic rocks (see follow[ing] abstract). W. C. S.

Barth (Tom. F. W.). *Studies on the igneous rock complex of the Oslo regi[on]. II. Systematic petrography of the plutonic rocks.* Skrifter Norske Videnskap-Akad. Oslo, I.Mat.-Naturv. Kl., 1945, no. 9 (for 1944), 104 pp., 23 fi[gs.], 1 map.

This study is based on the collection of rocks made by the late W. C. Brøg[ger] and described in his numerous, well-known papers. The author has assembl[ed] 54 chemical analyses of the rocks, some of them new. In discussing these analy[ses] he uses P. Niggli's method of calculating 'molecular norms' (Schweiz. Min. P[et.] Mitt., 1936, vol. 16, pp. 295–317). The advantages of this method are explained. The rocks of the old volcanic necks, which constitute Brøgger's essexite ser[ies] are shown to form a rock series ranging from basic gabbros, with their derivatives of pyroxenite and cumberlandite, to alkalic syenodiorites with their residual derivatives akerite, husebyite (a nepheline-syenite), hurumite, and windsorite. The residual derivatives occur either as border phases or as dikes and veins. Th[e] syenodiorite family is represented by a kauaiite group and a mafraite group. [The] pyroxenite differentiate of the kauaiite group is olivine-yamaskite (Brøgger, 1931). The name bojite (Weinschenk, 1897) is adopted for the group of 'essexites' of the diorite family. They are hornblende-diorites with primary hornblende and andesinic felspar. Rocks of the gabbro family represented are olivine-gabbro and hyperite. The Oslo deep-seated plutonics are found to form essentially one roc[k] mass, various types merging one into another. The chief types are: kjelsåsite (Brøgger, 1933), ranging from syenodiorite to granite; lardalite, larvikite, nordmarkite, ekerite, and some small occurrences of granite. The main granites of the Drammen district seem to occupy an independent position. Two minor rock series, probably of hybrid origin, are: a sørkedalite-*apotroctolite* series of troctolite-like rocks but containing sodic plagioclase and alkali-felspar; and a series, mentioned by Brøgger in 1933, including modumite, an anorthosite; and *hovlandite*, a syenogabbro unique in texture, with large plates of alkali-felspar enclosing small square crystals of bytownite. The interrelations of the rock series are discussed. In addition to rock analyses, new analyses of augite, aegirine-diopside, hornblende, and biotite are given. W. C. S.

Reinhard (Max). *Über die Entstehung des Granits.* (Rektoratsrede.) Basle: Universitätsreden, 1943, Heft 16, 38 pp.

Review of the literature with discussion. The following genetic types of granites are distinguished: (1) Juvenile granites by magmatic differentiation. (2) Metasomatic granites from sediments with exchange from solutions. (3) Palingene granites by anatexis of rocks of similar chemical composition (clays, sandstones, gneisses, granites), or by differential anatexis of rocks of different composition. [M.A. **9**–163.] L. J. S.

AMA (Th. G.). *On the chemistry of the east Fennoscandian rapakivi granites.* Compt. Rend. Soc. Géol. Finlande, 1945, no. 18 (Bull. Comm. Géol. Finlande, no. 136), 67 pp., 2 col. pls., 9 text-figs.

collection of 33 chemical analyses of acidic rapakivi granites gives mean es SiO_2 72·57 (range 64·23–77·71), Al_2O_3 12·62, Na_2O 2·30, K_2O 6·10, &c., ving more SiO_2 and K_2O, and less MgO, CaO, and Al_2O_3, than in ordinary uites. Analysis of a mixed sample from 54 localities gives similar results. The ence of trace elements is noted. Details are given of the occurrence in the ni area on lake Lagoda. L. J. S.

ELO NEIVA (J. M.). *Granitos e jazigos minerais de diferenciação magmática das Beiras e norte de Portugal.* Estudos, Notas e Trabalhos do Serviço de Fomento Mineiro, Porto, 1945, vol. 1, pp. 13–38, 10 figs. (With English summary.)

wenty-four (three by the author) chemical analyses of granites from this e massif are tabulated and plotted on diagrams; SiO_2 67·66–74·25 %. The ciated pegmatites contain Sn, W, Ta, U, Bi, and sometimes sulphides with and Ag. L. J. S.

LITELLI (Paolo). *Terre rare nel granito di Alzo: osservazioni spettrografiche.* Rend. R. Accad. Italia, Cl. Sci. Fis. Mat. Nat., 1940, ser. 7, vol. 2, pp. 87–92.

– *Sulla presenza di terbio, disprosio, olmio, erbio ed altre terre rare in una mica biotite de granito di Alzo.* Ibid., 1941, ser. 7, vol. 2, pp. 395–398.

– *Ricerche geo-petrochimiche sul massiccio eruttivo compreso fra la Valsesia ed il lago d'Orta.* Mem. R. Accad. Sci. Lett. Art. Modena, 1941, ser. 5, vol. 5, pp. 1–102, 3 pls., 4 text-figs.

pectrographic determination of trace elements in granite, biotite, tourmaline, mispickel from these localities in Piedmont. The third paper gives petrophical descriptions of various rocks with many chemical analyses. [M.A. 8–22.] L. J. S.

HER (D. Jerome). *Preliminary report on some pegmatites of the Custer district.* Rep. Invest. Geol. Surv. South Dakota, 1942, no. 44, 35 pp., 10 pls., 1 text-fig. (mimeographed).

– *Preliminary report on the mineralogy of some pegmatites near Custer.* Ibid., 1945, no. 50, v+92 pp., 17 pls., 3 maps, 2 text-figs. (mimeographed).

ive pegmatites in the Black Hills, South Dakota, are described. The first ect of these reports is to assist the working of the pegmatites for mica, beryl, l lithium-bearing minerals, but there is much information on the paragenesis he pegmatite minerals and on replacement processes. The layer pegmatites lenticular masses. Cavities are rare, but crystals of great size occur and some- es extend throughout the whole body of the pegmatite. At Keystone, a beryl ×5 feet and a spodumene 47 feet long and 3 to 6 feet wide were found. Tour- line crystals 2 feet long occur at Smith mine. Microcline-perthite forms sub- ral crystals several feet through. A great variety of minerals has developed hese pegmatites. The pyrogenic minerals are tourmaline (black), muscovite, rocline, and quartz. These are associated with albite, amblygonite (and ntebrasite, α 1·610, β 1·619, γ 1·630), apatite, beryl, cassiterite, cleavelandite, umbite, dufrenite (?), lepidolite, lithiophilite, löllingite, spessartine (2-inch

trapezohedra), tantalite, and lithium-tourmaline (elbaite). Sicklerite forms an alteration product of lithiophilite. 'Mineral A' of the text appears in the of errata on p. iv as a new mineral, *bastinite* [M.A. **9**–262]. Light blue sympl is formed as an alteration product of löllingite. Vivianite occurs as a blue on albite and cleavelandite at Old Mike lode where very remarkable pipe masses of cleavelandite were found. W. C. S

Oftedal (Ivar). *Lepidolit- og tinnsteinførende pegmatitt i Tørdal, Telem* Norsk Geol. Tidsskrift, 1943, vol. 22 (for 1942), pp. 1–14, 4 figs. (W English summary.)

Veins of cleavelandite-quartz-pegmatite replacing amazonite-pegmatite a the Telemark granite contain lepidolite (4–5 % Li_2O and some Mn), musc (1·5–2 % Li_2O), topaz (very large crystals), beryl (large crystals containing alkalis), gadolinite, spessartine, cassiterite, yttrotantalite, monazite, al microlite, and fluorite (very dark blue). The amazonite-pegmatite is very co grained with graphic structure; the amazonite is strongly coloured, and acces minerals are rare. This is the first find of lepidolite and cassiterite in Norwa L. J. S

Lyons (John B.). *Igneous rocks of the northern Big Belt range, Montana.* Bu Geol. Soc. Amer., 1944, vol. 55, pp. 445–472, 3 pls., 4 text-figs.

Thick beds of trachybasalt lava, breccias, and agglomerates are intruded sills and dikes of a magmatic-differentiation series ranging from gabbro to quar monzonite. Eight chemical analyses are given of the rocks (SiO_2 47·40–52· K_2O 2·41–4·75 %, &c.). Zeolitization is wide-spread with several varieties zeolites in veinlets and amygdules and replacing felspars. Analcime as phenocry up to 5 mm. across forms 5–15 % of an analcime-trachybasalt, and is conside to be of magmatic origin; it has sp. gr. 2·286, *n* 1·493, *a* 13·70 Å., CaO 1·19 K_2O much. Similar data are given for other K-rich analcimes. [M.A. **7**–448. L. J. S

Mennell (F. P.). *Note on alkaline igneous rocks in Southern Rhodesia.* Proc. Trans. Rhodesia Sci. Assoc., 1945, vol. 40, pp. 44–45.

Preliminary note on the occurrence of nepheline-syenite, melteigite, ijoli urtite, lestiwarite, shonkinite, pyroxenite, apatite-rock, &c., as ring intrusions the Sabi valley, similar to those of the Kola peninsula. L. J. S

Tomkeieff (S. I.). *Petrology of the Carboniferous igneous rocks of the Tweed bas* Trans. Edinburgh Geol. Soc., 1945, vol. 14, pp. 53–75, 1 fig.

The rocks described are extrusive and intrusive olivine-basalts (grain-size bel 0·1 mm.) and olivine-dolerites occurring in the lowest part of the Carbonifero in Berwickshire and Roxburghshire. The mineral composition and granulari have been measured for 38 rocks and there are new analyses of four olivi basalts and one olivine-dolerite. The basalts are of Jedburgh, Markle, Dalmer and Dunsapie types. The dolerites are felspar-rich types comparable with t Jedburgh and Markle basalts. A relation is indicated between the idiomorphi of the pyroxene and the pyroxene-ratio of the groundmass. W. C. S.

ONEN (Ahti). *Orbicular rocks in Kemijärvi and Esbo.* Compt. Rend. Soc. Géol. Finlande, 1941, no. 14 (Bull. Comm. Géol. Finlande, no. 126), pp. 107–139, 20 figs.

etailed petrographical descriptions with chemical analyses. The Kemijärvi was formed by metamorphic differentiation with granitization. The Esbo ('esboite') seems to have been formed from a basic pyroxene-gneiss by an sual metasomatic process ('esboitization') with addition of Na and Al and oval of Ca, Mg, and Fe. [M.A. **4**–40, **5**–226, **6**–304, **7**–305, **8**–238.] L. J. S.

(B. Rama). *The charnockite rocks of Mysore (southern India).* Bull. Mysore Geol. Dept., 1945, no. 18, iv+199 pp., 14 pls. Price 3 rupees.

harnockites and charnockitic rocks (hypersthene-granulites, pseudo-charnockites, and quasi-charnockites) are described from several localities in Mysore. y range from ultrabasic (dunite, pyroxenite, eclogite, &c.) to acid; nine yses show SiO_2 36·60–78·57 %. They have been derived from sediments basic intrusive rocks by repeated metamorphism and granitization with plete recrystallization of the material. The abundant hypersthenes are ded into the common magnesian (anal. I), aluminous (= 'bidalotite' [M.A. **7**–, and iron-rich (anal. II) types.

	SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	MgO.	CaO.	Na_2O.	K_2O.	H_2O.	Total.
	52·66	trace	1·28	5·47	9·34	0·89	26·58	3·30	0·84	0·18	0·19	100·73
	51·16	nil	3·44	5·20	35·75	nil	4·51	nil	—	—	nil	100·06

L. J. S.

DU (P. R. J.). *Orientation of hair-like inclusions in the quartz of charnockites.* Quart. Journ. Geol. Mining Metall. Soc. India, 1945, vol. 17, p. 17, 1 pl.

paque black acicular inclusions in the quartz of Indian charnockites and of ynite from Pallavaram, Madras, have generally a random orientation, though imes they show angles of 30° or 120°. L. J. S.

DER (Rex T.). *Charnockitic and related cordierite-bearing rocks from Dangin, Western Australia.* Geol. Mag. Hertford, 1945, vol. 82, pp. 145–172, 7 figs.

etrographical descriptions with four chemical analyses are given of hypersites ('ultrabasic charnockites'), plagioclase-hornblende-pyroxene-granulites sic charnockites') and hybrid gneisses ('acid charnockites') of various types. y are considered to represent basic intrusions, which have in part been taminated by assimilation of aluminous metasediments, giving cordierite-ring rocks; and in part subjected to granitization, giving acid charnockites containing the original hypersthene. L. J. S.

KER (George). *Eclogite inclusion from Cape Paterson volcanic neck in South Gippsland, Victoria.* Amer. Min., 1945, vol. 30, pp. 505–509, 1 fig.

small (10 grams) rounded specimen of very fresh eclogite consists of granular net (red almandine-pyrope) and pyroxene (green omphacite, n 1·675, $\gamma : c =$ 2V 60–80°, positive). Narrow kelyphite rims partly surrounding some of garnets contain minute grains of violet-coloured spinel. The few recorded urrences of eclogite in Australia are all as blocks in volcanic necks.

L. J. S.

Fiala (František). *Kontaktní a intrusivní horniny silničního profilu u Zbořené Kostelce.* [Contact and intrusive rocks of the high-road profile near Zbořené Kostelec.] Věstník Královské České Společnosti Nauk, 1943, no. 4, 72 pp., 4 pls., 3 text-figs. (German abstract, 41 pp.)

At the contact of the central Bohemian granodiorite massif with ancient sediments compact metamorphic rocks and migmatites of diverse composition have originated. In addition to the commoner types described in detail, there is a corundum-bearing hornfels, in which the porphyroblasts of corundum are for the most part altered to muscovite; the rest of the rock consists of felspar, muscovite, biotite, cordierite, and accessory magnetite, apatite, rutile, spher and rare tourmaline porphyroblasts. Another hornfels is an amphibolite with two varieties of amphibole: (1) ferroanthophyllite with pleochroism α pa yellowish-green almost colourless, β-greenish-brown, γ dark violet-brown between 1·681 and 1·689, axial plane (010); (2) cummingtonite with we pleochroism and lower refractive indices, $\gamma : c = 19°$; medium plagioclases ma up the rest of the rock. F. S.

Magnée (I. de) & Anciaux (P.). *Note préliminaire sur le métamorphisme grenats du Brabant.* Bull. Soc. Belge Géol. Bruxelles, 1945, vol. 54, pp. 77-8 2 pls.

Siluro-Cambrian phyllites and fine-grained schists in Dyle valley conta spessartine (up to 50 % of the rock) with sericite, chlorite, and quartz. Th spessartine has the form of rhombic-dodecahedra 0·1–0·15 mm. across, and ga SiO_2 36·5, Al_2O_3 18·5, Fe_2O_3 3·5, FeO 13·5, MnO 25·5, MgO 2·5 = 100·0. L. J. S.

Plaza (Gil Rivera). *Patoita.* Bol. Soc. Geol. Peru, 1945, vol. 18, pp. 89–9 4 figs.

A laminated metamorphic rock from cañon Pato, dep. Ancash, is nam patoite by J. A. Broggi (loc. cit., p. 78). It has a crystalloblastic texture an consists of quartz, biotite, secondary muscovite, orthoclase, oligoclase, garne andalusite, and staurolite, with accessory sillimanite, zircon, apatite, an graphite. Analysis gave SiO_2 46·05, TiO_2 1·20, Al_2O_3 37·50, Fe_2O_3 2·76, FeO 5·(MgO 1·74, CaO 1·77, Na_2O 0·50, K_2O 0·38, P_2O_5 0·09, SO_3 1·07, Cl trace, F tra C 1·18, H_2O+ 0·64, H_2O- 0·12 = '99·96'. L. J. S.

Brown (I. C.). *Brucite in limestone near Wilkinson, Ontario.* Econ. Geol., 194 vol. 38, pp. 408–419, 2 figs.

Brucite as disseminated granules, blades, and needles, in magnesian limesto about 30 miles north of Kingston, contains no remnants of periclase and is co sidered to have resulted directly from the hydration of dolomite. M. A. P.

Mortensen (Odd). *Vannholdige magnesiasilikater dannet ved metasomatose dolomitiske kalkstener.* [Hydrous magnesium silicates formed by met somatism of dolomitic limestones.] Norsk Geol. Tidsskrift, 1945, vol. 2 pp. 266–284, 6 figs. (With English summary.)

A small area of crystalline limestone containing serpentine, talc, and tremoli near Tengesdalsvatn is surrounded by a zone of silexite (95 % quartz, 5

rite) grading into granite. The magnesium silicates were formed by the action ntroduced SiO_2 on dolomitic limestone, some remnants of which are present.
L. J. S.

LLIAMSON (W. O.). *Some grits and associated rocks in the Etruria Marls of north Staffordshire.* Geol. Mag. Hertford, 1946, vol. 83, pp. 20–32, 2 figs.

lastic fragments in these rocks of the Upper Coal Measures suggest derivation n pre-Cambrian and Cambrian rocks. The matrix of the fragments consists rhombohedral carbonates showing spherulitic structures, and of a green neral identified with chamosite. A purplish calcareous rock forming a thin er in the marls at Chesterton carries 4·42 % MnO. W. C. S.

XD (Geoffrey). *Solution etching of detrital staurolite.* Geol. Mag. Hertford, 1943, vol. 80, pp. 155–156.

andstone of aeolian origin of Karroo age and lying beneath a basalt flow at da's Kraal, 25 miles north of Bulawayo, Southern Rhodesia, contains few vy minerals including: well-rounded grains of zircon and tourmaline; sub- nded grains of staurolite usually with etched terminations. [M.A. **8**–237.]
L. J. S.

KER (George). *The heavy minerals of some Victorian granitic rocks.* Proc. Roy. Soc. Victoria, 1942, new ser., vol. 54, pp. 196–221, 3 figs.

From 109 granites (sp. gr. 2·53–2·69, average 2·62) and granodiorites (sp. gr. 58–2·76, av. 2·67) 33 heavy (including Fe-Mg) minerals were isolated and bulated; 23 chemical analyses of the rocks are quoted. L. J. S.

Artificial Minerals

ASLENITSKY (I.). *On some cases of formation of disperse gold segregations in iron sulphides.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1944, vol. 45, pp. 385–388, 2 figs.

Pyrite often contains more gold than can be extracted by panning or with ercury or cyanide, and this excess cannot be detected under the microscope. yrite and pyrrhotine prepared at 400° C. with gold chloride or colloid gold owed some particles of gold and more became visible on further heating the aterial, owing to the segregation of fine particles. Some of the invisible gold ay be present as Au_2S_3, which was prepared from precipitated gold sulphide eated at 160–165° C. under a pressure of 5000 kg. per sq. cm.; this is lead-grey ith a perfect cleavage and optically anisotropic, H. 2½. L. J. S.

RIFFITH (R. H.) & MORCOM (A. R.). *The interconversion of iron oxides and sulphides.* Journ. Chem. Soc. London, 1945, pp. 786–790, 4 figs.

The sorption of H_2S by α- or β-Fe_2O_3, α-, β-, γ-, δ-, or amorphous $Fe_2O_3.H_2O$ these were distinguished by their solubility in dilute HCl and magnetic properties) ields in the first place $Fe_2S_3.H_2O$ [melnikovite?]. With excess of H_2S above 0° C. this passes into a mixture of FeS_2 and magnetic Fe_8S_9. Oxidation of moist Fe_2S_3, Fe_8S_9, or precipitated FeS gives α-$Fe_2O_3.H_2O$ below 50°, and γ-Fe_2O_3 bove 50°. [M.A. **4**–480, **8**–96, **9**–202.] L. J. S.

Schiavinato (Giuseppe). *Sulla jaipurite sintetica.* Periodico Min. Roma, 19[illegible] vol. 11, pp. 155–162, 1 pl.

Continuing the work of T. Carpanese [M.A. 7–143], crystals, up to 1 mm., of CoS were obtained by passing $H_2S+HCl+N$ over CoO heated at 900°. These brass-yellow hexagonal bipyramids with brilliant metallic lustre, $(10\bar{1}1)$ w $(10\bar{1}0)$ and (0001); $a : c = 1 : 1{\cdot}5474$. Analysis gave Co 64·67, S 35·49, Cl [M.A. 3–19.] L. J. S.

Andrieux (Jean-Lucien) & Canaud (Albert). *Sur la préparation électrolytiq[illegible] les propriétés des arséniures de fer.* Compt. Rend. Acad. Sci. Paris, 19[illegible] vol. 218, pp. 710–711.

White, non-magnetic crystals of FeAs and $FeAs_2$ [löllingite] and interme[illegible] mixed crystals were prepared electrolytically in fused mixtures of $KAsO_3$, N[illegible] and $FeCl_3$ or of $Na_4As_2O_7$, NaCl, and Fe_2O_3. No evidence was obtained fo[illegible] compound Fe_2As_3. L. J. S.

Bergman (A. G.) & Dergunov (E. P.). *Fusion diagram for the system KF–Na[illegible] MgF_2.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1945, vol. 48, pp. [illegible] 331, 2 figs.

The three compounds in this system are $2KF.MgF_2$, $KF.MgF_2$, and $NaF.Mg[illegible]$ Melting-points are: KF 850°, NaF [villiaumite] 990°, MgF_2 [sellaite] 1270°. L. J. S.

[Simon (A.), Ancot (H.), & Christiansen (H.). *Beiträge zur Kenntnis [illegible] Ferritbildung und -reduktion unter den Bedingungen der Zinkverhüttu[illegible]* Zeits. Elektrochem. 1940, vol. 46, pp. 458–480. Also in Höppner (H[illegible] Diss. Dresden, 1941.]

Simon (A.) & Höppner (H.). *Untersuchungen über Bildung, Reduzier- und Lau[illegible] barkeit von Zinkferriten und ferritreichen Zinkblenderöstprodukten. II. M[illegible] teilung.* Ibid., 1943, vol. 49, pp. 296–305, 7 figs.

Christophite when roasted at about 400° yields $Fe_2(SO_4)_3$ and $FeSO_4$, at 65[illegible] $ZnSO_4$, at 800° ZnO, at 1000° $ZnO.Fe_2O_3$, and at 1300° probably other zinc ferrit[illegible] L. J. S.

Fréchette (V. D.) & Andrews (A. I.). *Investigation of reactions of simp[illegible] magnesia spinels with alkaline earth orthosilicates in the solid state.* Jour[illegible] Amer. Ceramic Soc., 1944, vol. 27, pp. 197–202, 3 figs.

Spinels ($MgAl_2O_4$, $MgCr_2O_4$, and $MgFe_2O_4$) and orthosilicates of Mg, Ca, Sr, a[illegible] Ba were prepared by heating the mixed oxides in the solid state, and the reacti[illegible] of these on each other as mixed powders or pellets was examined. There w[illegible] some exchange between Cr and Si, and *n* of spinel was slightly reduced. Forsteri[illegible] and $SrAl_2O_4$ were also formed. L. J. S.

Filonenko (N. E.). *On some high-alumina minerals in a block of electrocorundu[illegible]* Compt. Rend. (Doklady) Acad. Sci. URSS, 1945, vol. 48, pp. 430–433.

The artificial abrasive 'electrocorundum' prepared by reduction smelting bauxite in an electric-arc furnace consists of corundum and anorthite when the is sufficient SiO_2 present to combine with CaO. With a deficiency of SiO_2 the

rmed $CaO.6Al_2O_3$ as hexagonal lamellae (I–III) together with corroded grains orundum (IV), and the abrasive efficiency is lowered. The colours are due to nium.

	SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	CaO.	Total.	Sp.gr.	ω.	ϵ.
Green	2·08	8·78	80·22	0·75	8·67	100·50	3·64	1·790	1·780
Blue	1·98	4·48	84·02	0·86	8·71	100·05	3·61	1·785	1·776
Colourless ...	0·36	0·53	91·04	0·86	7·32	100·11	3·54	1·757	1·750
Pink	0·34	0·58	97·59	1·78	0·02	100·31	3·96	1·768	1·760

A. **9**–90, 133.] L. J. S.

LANCA (Angelo). *Natura e sintesi dell' alstonite.* Periodico Min. Roma, 1941, vol. 12, pp. 127–144, 1 pl., 7 text-figs.

thermal study of the system Li_2CO_3–$BaCO_3$–$CaCO_3$ suggests the formation double salt $CaBa(CO_3)_2$. Fusion of $CaCO_3+BaCO_3$ with NaBr gave small $\times 0{\cdot}2$ mm.) crystals of tabular habit and not twinned; α 1·525, γ 1·68, 2V 7°, tive; the X-ray powder pattern is identical with that of natural alstonite and inct from those of aragonite and witherite. The following data (from the ature) show that those for alstonite do not fall midway between those for gonite and witherite.

	'Sp. vol.'	α.	β.	γ.	2V.	a.	b.	c.
gonite	22·63	1·5295	1·6805	1·6848	18·11°	7·94	4·94	5·72Å.
onite	26·74	1·525	1·673	1·673	7·14	8·77	4·99	6·11
herite	29·79	1·529	1·676	1·677	16·00	8·83	5·25	6·54

L. J. S.

INALE (M.). *Su di una nuova sintesi della brochantite.* Rend. Soc. Min. Ital., 1941, vol. 1, p. 34.

$NaNO_2$ added to a solution of $CuSO_4$ gave a pale-blue precipitate with the composition $CuSO_4.3Cu(OH)_2$ and with the optical and X-ray data of brochantite. L. J. S.

ASNIKOV (V. S.), Мясников (В. С.). *Production of synthetic scheelite with reference to its origin in nature.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1941, vol. 33, pp. 412–414.

he frequent occurrence of scheelite in quartz veins without fluorine or chlorine nerals suggests that tungsten may have been carried as a silicon compound. solution of $Ca(HCO_3)_2$ added to one of silicotungstic acid ($H_8Si(W_2O_7)_6$) posited, after boiling off CO_2, a white powder of $CaWO_4$. A solution of silicogstic acid heated with $CaCO_3$ in an autoclave at 250° C. yielded a granular vder of scheelite, which gave an intense violet fluorescence in cathode rays. heelite is not acted upon by a solution of $Ca(HCO_3)_2$, but meymacite yields WO_4. Acid weathering by sulphate waters of scheelite and wolframite yields ymacite and tungstite, and these by alkaline weathering with $Ca(HCO_3)_2$ uld give rise to a migration of secondary scheelite. L. J. S.

NGUZZI (Carlo). *Apatiti sintetiche con cromo trivalente ed esavalente.* Periodico Min. Roma, 1941, vol. 12, pp. 343–380, 1 pl., 1 text-fig. Rend. Soc. Min. Ital., 1941, vol. 1, pp. 40–42 (abstract).

Mixtures of $Ca_3(PO_4)_2+CaCrO_4+CaCl_2$ fused at 1100° yielded bright green, nsparent crystals with $Cr^{+3}+2Cr^{+6}$ in place of $3P^{+5}$ (15 valencies). Crystals

on the surface of the melt were slender needles up to 2 cm. long, while those in the body of the melt are short hexagonal prisms (1 mm.) with bipyramids. The depth of colour and refractive indices, ϵ 1·666–1·707, ω 1·668–1·710, increase with amount of Cr. Pleochroism, ϵ bright yellowish-green, ω dark blue. Analysis one crop gave P_2O_5 38·30, CrO_3 1·84, Cr_2O_3 0·75, CaO 53·97, Cl 6·80 = 101 agreeing with $Ca_{10}(P,Cr^{+3},Cr^{+6})_6O_{24}Cl_2$. Another crop, from a fusion with Na_2 in place of $CaCrO_4$, gave P_2O_5 34·41, CrO_3 4·23, Cr_2O_3 0·79, CaO 55·24, Na_2O Cl 6·52 = 101·71. The various substitutions possible in apatite are discussed many references to the literature. [M.A. **8**–141, 343; **9**–13.] L. J. S.

Rigby (G. R.), Lovell (G. H. B.), & Green (A. T.). *The reversible the expansion and other properties of some calcium ferrous silicates.* [Bull. Refract. Res. Assoc., 1943, no. 65]; Trans. Brit. Ceramic Soc., 1945, vo pp. 37–52, 10 figs.

The system CaO–FeO–SiO_2 is reviewed [M.A. **5**–454]. Optical, density, thermal expansion determinations were made on preparations of fay (Fe_2SiO_4), iron-monticellite ($CaFeSiO_4$), and mixed crystals of wollastonite $FeSiO_3$, these being minerals of importance in slags. L. J. S.

Reinhard (M.), Brandenberger (E.), & Oesterheld (G.). *Bildung und fernung von kieselsäurehaltigem Kesselstein.* Helvetica Chim. Acta, 19 vol. 25, pp. 336–352, 8 pls., 1 text-fig.

A series of boiler scales deposited from water containing SiO_2 0·0007–0·0012 differ in character and composition. A hard scale containing SiO_2 47·5% g X-ray data suggesting wollastonite, but this is not confirmed by a microscopi examination, n 1·59 being too low. A soft scale (SiO_2 35·8%) gave X-ray a optical data suggesting xonotlite. Other minerals present are calcite, aragon anhydrite, and haematite. L. J. S.

Balconi (M.). *Sintesi della sillimanite.* Rend. Soc. Min. Ital., 1941, vol. 1, pp. 82–86, 1 fig.

A mixture of $Al_2O_3+SiO_2$ in equal molecular proportions with 50% borax 4% MgO heated at 950° and held at 850° for 24 hours gave a crystalline prod Al_2O_3 63·55, SiO_2 36·94%, with the X-ray pattern of sillimanite. [Earlier rep of the artificial production of sillimanite must be referred to mullite. In Annual Report of the Geophysical Laboratory, Carnegie Institution of Wash ton Year Book, 1941, no. 40 for 1940–41, p. 35, mention is made of the f production of sillimanite as long needles deposited from water vapour at h temperature and pressure.] L. J. S.

Geller (R. F.) & Bunting (E. N.). *Report on the systems lead oxide–alumina lead oxide–alumina–silica.* Journ. Res. Nat. Bur. Standards, U.S.A., 19 vol. 31, pp. 255–270, 4 figs. (Research Paper 1564).

$PbO.Al_2O_3$ is unstable, breaking down at 970° C. into corundum and glass. the ternary system compounds identified are $8PbO.Al_2O_3.4SiO_2$, $4PbO.Al_2O_3.2Si$ and $6PbO.Al_2O_3.6SiO_2$; also four others of undetermined composition which optical and X-ray data are given. Al_2O_3(> 99·9 %) has melting-po 2035±10° C. L. J. S.

AYZE (Myron A.). *A report on studies of*—1. *The ternary system* $CaO–C_5A_3–C_2F$. 2. *The quaternary system* $CaO–C_5A_3–C_2F–C_2S$. 3. *The quaternary system as modified by* 5% *magnesia*. Amer. Journ. Sci., 1946, vol. 244, pp. 1–30, 65–94, 1 pl., 11 text-figs.

n connexion with the burning of Portland cement clinkers the systems $CaO–3CaO.3Al_2O_3–2CaO.Fe_2O_3$ and $CaO–5CaO.3Al_2O_3–2CaO.Fe_2O_3–2CaO.SiO_2$ were lied in melts of mixtures of $CaCO_3$, Al_2O_3, Fe_2O_3, and SiO_2. A new compound $O.2Al_2O_3.Fe_2O_3$ is orthorhombic with α 1·94, 2V small, negative, and the same ay pattern as $4CaO.Al_2O_3.Fe_2O_3$ [brownmillerite, Min. Mag. **26**–335]. L. J. S.

MMER (W. K.). *The system* $CaSiO_3–CaAl_2Si_2O_8–NaAlSiO_4$. Journ. Geol. Chicago, 1943, vol. 51, pp. 503–530, 17 figs.

quilibrium diagrams in this small portion of the system $Na_2O–CaO–Al_2O_3–{}_2$ show fields of anorthite, pseudowollastonite, nepheline, carnegieite, gehlenite, corundum. The courses of crystallization are discussed. L. J. S.

VAK (Joseph). *The system* $NaAlSiO_4–CaSiO_3–Na_2SiO_3$. Journ. Geol. Chicago, 1944, vol. 52, pp. 24–52, 17 figs.

Equilibrium diagrams in a second portion of the same plane of the system $_2O–CaO–Al_2O_3–SiO_2$ dealt with in the preceding paper [the third portion of s plane includes the system anorthite–nepheline–sillimanite] shows fields of udowollastonite, nepheline, carnegieite, $Na_2O.2CaO.3SiO_2$, $2Na_2O.CaO.3SiO_2$, d Na_2SiO_3. L. J. S.

WEN (Norman L.). *Phase equilibria bearing on the origin and differentiation of alkaline rocks*. Amer. Journ. Sci., 1945, vol. 243A (Daly volume), pp. 75–89, 8 figs.

Equilibrium relations of portions of the system $Na_2O–CaO–Al_2O_3–SiO_2$ [preling abstracts] show that certain melts crystallized non-fractionally will give elilite, nepheline, and wollastonite, while the same melts crystallized fractionally ll give also plagioclase at first calcic and finally sodic. Melilite-nephelinite, phrite, and phonolite, and also residual liquids rich in alkali silicates, may thus velop, without the desilicification of magmas by assimilation of limestone. [.A. **9**–174.] L. J. S.

RÖGER (Carl) & ILLNER (K. W.). *Über die Systeme Alkalioxyd–CaO–*$Al_2O_3–SiO_2–CO_2$. *X. Die Gleichgewichte in dem quaternären System* $Na_2O–CaO–SiO_2–CO_2$. Zeits. Anorg. Chem., 1940, vol. 243, pp. 209–230, 11 figs.

A pressure-temperature diagram shows the compounds $Na_2Ca(CO_3)_2$, $Na_2Si_2O_5$, $a_2O.3CaO.6SiO_2$, $2Na_2O.CaO.3SiO_2$, and Na_2SiO_3. X-ray data are given. L. J. S.

Meteorites and Tektites

AYLEIGH (*Lord*). *Meteorites and some of the problems which they present*. Endeavour (Imp. Chem. Ind.), 1944, vol. 3, pp. 127–134, 8 figs.

A general account, with particular reference to the artificial simulation of the ructure of pallasites [M.A. **8**–372]. Mention is made of the problem of the silicaass of the Libyan Desert [Min. Mag. **25**–432]. L. J. S.

Marshall (Roy K.). *Things that fall from the sky. Meteors and meteor* Philadelphia, Pennsylvania (Franklin Institute), 1944, 16 pp., 13 figs.

A clear account of meteors, comets, fireballs, and meteorites, including instr tions for observing and recording the apparent path of a meteorite in flight list of the large meteorites of the world is given on the cover. W. C. F.

Stocking (Hobart E.). *Bombs.* Nat. Hist. (Amer. Mus. Nat. Hist.), 19 vol. 53, pp. 28–32, 48, 7 figs.

A popular article on the Siberian (Tunguska) meteorite of 1908, with gene remarks on meteorites and meteorite craters. L. J. S.

Lane (Frank W.). *The elements rage.* London (Country Life), 1945, xii+188 47 pls. Price 10*s.* 6*d.*

A series of chapters giving general and popular accounts of hurricanes, to does, waterspouts, hail, snow, lightning, meteorites (pp. 97–125, pls. 29– earthquakes and volcanoes. L. J. S.

Leonard (Frederick C.). *Meteorites: immigrants from space.* Publ. Astron. Pacific, San Francisco, 1945, vol. 57, pp. 5–15, 4 pls.

A lecture giving a general account of meteorites. L. J. S.

Bosler (Jean). *Sur une averse de météorites mentionnée dans la Bible.* Comp Rend. Acad. Sci. Paris, 1943, vol. 216, pp. 597–599.

The fall of stones and the standing still of the sun mentioned in Joshua x. 11–1 are thought to be connected phenomena. L. J. S.

Rickard (T. A.). *The use of meteoric iron.* Journ. Roy. Anthropological Ins London, 1941, vol. 71, pp. 55–66, 2 pls.

Mention is made of the use of meteoritic iron by primitive man for maki weapons and tools, with special reference to the Cape York siderites and t Ovifak terrestrial iron used by the Eskimos. General remarks on meteorites a added. [M.A. **1**–44, **5**–151.] L. J. S.

Daly (Reginald A.). *Meteorites and an earth-model.* Bull. Geol. Soc. Amer., 194 vol. 54, pp. 401–455.

A highly speculative but stimulating essay. Meteorites are postulated to from the break-up of a 'parent planet', perhaps between Mars and Jupiter, of a assumed radius of 3000 km. and an iron core 1000 km. radius, this giving abo the same proportion of stone and metal as in meteorites observed to fall, and mean density of 3·77. The processes of differentiation and zoning of material in t originally gaseous, later liquid, mass and stages of crystallization are elaborate 'Two-phase convection led to sudden pressure-freezing at depth' where hig viscosity, together with tidal shearing, crushing, and plastic flowage, would gi a fragmentary and porous aggregate of small grains. Chondrules were perha rounded by friction from tidal kneading. An earth-model (ten times the volum is built up on similar lines. Nine shells are suggested. Beneath granite an

idotite, a weak vitreous basaltic layer (asthenosphere) is followed by achron-ic, chondritic, and stony-iron meteoritic material, with a core of fluid metal. s is discussed in relation to viscosity, plasticity, rigidity, compressibility, nperature, radioactivity, &c. L. J. S.

DDING (Assar). *Stammen die Meteoriten von der Erde her?* Geol. För. Förh. Stockholm, 1943, vol. 65, p. 30.

Material violently ejected from a long volcanic pipe may possibly reach outside limit of the earth's attraction, and return to earth later. L. J. S.

DDING (Assar). *The final velocity of meteorites.* Kungl. Fysiograf. Sällsk. Lund Förh., 1941, vol. 10 (for 1940), no. 14, 7 pp.

The high velocity of meteors can be calculated from the observed length of ; after extinction this must be much less. From the time that whistling ds were heard when the Skane-Tranas [M.A. **7**–540], Hedeskoga [M.A. **3**–93], Ekerby [M.A. **8**–57] meteorites fell in south Sweden it is concluded that the l velocity was less than that of sound, and for Ekerby estimated at 150 metres second. L. J. S.

STAFSON (Torsten). *Some calculations on the retardation of meteorites.* Kungl. Fysiograf. Sällsk. Lund Förh., 1941, vol. 10 (for 1940), no. 15, 5 pp., 2 figs.

The calculations are based on the increasing air density and resistance for a herical mass of density 3 entering the earth's atmosphere with a velocity of 000 metres per second. For a mass of 12,500 kg. the final velocity would be 00, for one of 12·5 kg. 132, and for one of 0·125 kg. 64 m./s. L. J. S.

PAZ (Lincoln). *An electromagnetic cane for meteoriticists.* Pop. Astron., 1945, vol. 53, pp. 402–405, 1 fig.

A coil of wire on a brass tube, which can be slid along an iron rod (for probing o the ground), is activated by a 6-volt battery carried in a knapsack. A 1lb. ass of iron can be picked up. L. J. S.

PAZ (Lincoln). *Remarks on four notes recently published by C. C. Wylie.* Pop. Astron., 1943, vol. 51, pp. 339–343; Contr. Soc. Res. Meteorites, [1944], vol. 3 (for 1943), pp. 93–97.

A discussion on contraterrene meteorites [M.A. **8**–62, 191] and on the probable ass of the Canyon Diablo meteorite [M.A. **8**–378]. L. J. S.

PAZ (Lincoln). *Meteoritical position problems.* Pop. Astron., 1944, vol. 52, pp. 300–306, 2 figs.; Contr. Soc. Res. Meteorites, [1945], vol. 3 (for 1944), pp. 148–153, 2 figs.

ONARD (Frederick C.). *On the assignment of co-ordinate numbers to meteoritic falls.* Ibid., pp. 306–307; ibid., pp. 153–155.

The importance of stating the latitude and longitude of the place of meteorite ls is stressed. In the case of finds the possibility of the mass having been nsported should be considered; examples of some doubtful cases are given. [M.A. **8**–189; **9**–289, 301.] L. J. S.

Herbig (George H.). *A study of the multiple meteoritic falls of the world.* Pop. Astron., 1943, vol. 51, pp. 455–459; Contr. Soc. Res. Meteorites, [1943] vol. 3 (for 1943), pp. 103–107.

Falls of stones, siderites, and lithosiderites are tabulated according to the number of times 1, 2, 3 . . . thousands of masses have been recorded. The data examined by the method of contingency supports the view that the more friable stones have been broken up in the earth's atmosphere. L. J. S.

Khán (Mohd. A. R.). *Hissing sounds heard during the flight of fireballs.* Nature, London, 1944, vol. 155, p. 53.

—— *On the cause of the hissing sounds heard during the flight of certain meteorites.* Pop. Astron., 1945, vol. 53, pp. 39–40.

The hissing noise sometimes heard during the flight of a fireball is attributed to the falling through the atmosphere of material ablated from a friable aerolite. Immediately after the passage of a fireball over Hyderabad on October 9, 1936, a shower of fine 'sand' was noted beating against the leaves of trees. L. J. S.

Wilson (Ben Hur). *The jurisprudence of meteorites.* Mineralogist, Portland, Oregon, 1943, vol. 11, pp. 171–172, 188–191.

The lawsuits for the possession of the Iowa meteorites, Homestead (fell 1875), Estherville (1879), and Forest City (1890), are recalled. The ruling of the Iowa Courts was that they were the property of the owner of the land on which they fell. Another case was that of Willamette (found 1902) [M.A. 8–376]. Meteorites found on public lands are the property of the state and are deposited in the United States National Museum. L. J. S.

Carpenter (Roy R.). *A legal treatise on meteorites, or, did you ever see a "Tomanowas"?* Pop. Astron., 1945, vol. 53, pp. 186–192, 238–241.

Notes from court reports and law journals of the few cases that have dealt with the ownership of meteorites. The Willamette siderite [M.A. 7–379, 8–376] was known to the Indians as 'Tomanowas'. L. J. S.

La Paz (Lincoln). *On the ownership of recovered meteorites.* Pop. Astron., 1946, vol. 54, pp. 93–95.

The legal ruling that a meteorite is the property of the landowner is absurd and against the interests of science. L. J. S.

Leonard (Frederick C.). *On the classification of meteorites.* Pop. Astron., 1945, vol. 52, pp. 148–151, correction, p. 199; Contr. Soc. Res. Meteorites, [1945] vol. 3 (for 1944), pp. 134–136, correction, p. 142.

The group of siderolites, intermediate between aerolites ('stones') and siderites ('irons'), fall into two main subdivisions: 'irony stones' now termed sideraerolites and 'stony irons' or lithosiderites, which in the Rose-Tschermak-Brezina classification have been placed respectively under 'stones' and 'irons'. [M.A. 8–370] L. J. S.

LEONARD (Frederick C.). *On the place of meteorites in the cosmos.* Pop. Astron., 1944, vol. 52, pp. 351–354; Contr. Soc. Res. Meteorites, [1945], vol. 3 (for 1944), pp. 161–164.

A tabulated 'inventory of the universe' includes meteorites in the solar and stellar systems, as well as those fallen on the earth. Cosmolite is a more appropriate term than meteorite. L. J. S.

LEONARD (Frederick C.). *The use of coördinate numbers of meteoritic falls in numbering specimens in collections.* Pop. Astron., 1945, vol. 53, pp. 86–87.

The system of numbering, based on the latitude and longitude of the place of fall, attached to specimens would itself identify them and would be the same in all collections. [M.A. **9**–287.] L. J. S.

LEONARD (Frederick C.). *Working definitions of fundamental terms on meteoritics.* Pop. Astron., 1945, vol. 53, pp. 244–245.

'*Meteorite* (adj., meteoritic): (1) a solid body of subplanetary dimensions existing as a discrete unit in space—called specifically a *meteorite in space* [to replace the term meteoroid]; or (2) a solid body from space that is falling or has fallen as a separate unit onto the Earth or onto some other astronomical body—called specifically a *falling* or a *fallen meteorite*. *Meteor* (adj., meteoric): the incandescence that results when a meteorite in space collides with the atmosphere of the Earth or with that of some other astronomical body and becomes, usually, a falling meteorite. *Meteoritics* (adj., meteoritical): the science of meteorites and meteors. *Meteoriticist*: a specialist in meteorites.' L. J. S.

LEONARD (Frederick). *Studies of the meteoritic falls of the world: 6. Doubtful and duplicate falls and falls having uncertain and intermediate classifications.* Pop. Astron., 1945, vol. 53, pp. 464–472. [M.A. **8**–370.]

A list is given of the classification symbols of meteorites. Lists are given of doubtful falls; of suggested identities; and of meteorites of uncertain classification, some of which have been placed in more than one group. L. J. S.

LEONARD (Frederick C.). *Studies of the meteoritic falls of the world. 7. Numbers and percents of observed and unobserved falls of all classes.* Pop. Astron., 1946, vol. 54, pp. 44–48.

The numbers and percentages of observed and unobserved falls of 1220 known meteorites are listed under 137 groups and classes. For all, the observed falls are 8·1 %; for stones 76·9 %, for siderolites 17·9 %, and for siderites 6·1 %. There is at least one observed fall in every class of stones, but not so for siderolites and siderites. L. J. S.

LORD (J. O.). *Structural history of iron meteorites.* Bull. Geol. Soc. Amer., 1940, vol. 51, p. 2040.

Brief preliminary abstract of a paper published later [M.A. **8**–375]. L. J. S.

HENDERSON (E. P.) & PERRY (Stuart H.). *Meteorites and their metallic constituents.* Ann. Rep. Smithsonian Institution, Washington, 1943, for 1942, pp. 235–251, 6 pls., 2 text-figs.

Some general remarks on meteorites are followed by tabulations of chemical analyses of hexahedrites, octahedrites, and nickel-rich ataxites. The ratio

Fe/(Ni+Co) ranges from 16·8 in hexahedrites to 3·4 in nickel-rich ataxites. The structure of siderites seems to depend not only on the percentage of nickel, but also on the conditions of heating and the rate of cooling. A plot of the ratio Fe/(Ni+Co) against percentage of metal present in chondritic stones shows a general increase in both—when the metal is in small amount it is richer in nickel. The metal in stony meteorites appears to be a later introduction. L. J. S.

Perry (Stuart H.). *The metallography of meteoric iron.* Bull. U.S. Nat. Mus. 1944, no. 184, vii+206 pp., 3+78 pls., 9 text-figs. Price 60 cents.

A useful summary is given of the technique of metallographic methods together with an outline of the iron-carbon and iron-nickel systems. The various constituents and structures shown by meteoritic irons are described in detail and compared with those of artificial irons. A prominent feature of the volume is the profusion of excellent illustrations, 315 in number with descriptive accounts and representing 97 meteorites. These have been selected from a collection of about 1300 photomicrographs, with magnification up to 2000 diameters, which have been deposited, together with the negatives, in the United States National Museum. L. J. S.

Nininger (H. H.). *Directions for the etching and preservation of metallic meteorites.* Pop. Astron., 1945, vol. 53, pp. 82–86.

Detailed instructions are given for etching siderites with a 6% aqueous solution of HNO_3, or (when minute inclusions of sulphide produce stains) with a 5% alcoholic solution of HNO_3 ('nitrol'). After etching, specimens should be well washed, quickly dried, and lacquered, and afterwards not exposed to abrupt changes of temperature (as in an exhibition case exposed to direct sunlight). L. J. S.

Buddhue (John Davis). *A note on the chemical elements not found in meteorites.* Pop. Astron., 1946, vol. 54, p. 152.

Only 5 of the known 92 elements have not been recorded in meteorites: illinium (atomic no. 61), xenon (54), krypton (36), virginium (ekacaesium, 87), alabamine (ekaiodine, 85). L. J. S.

Byers (Horace G.). *Selenium in meteorites.* Indust. Engin. Chem. News Edit. (Amer. Chem. Soc.), 1938, vol. 16, p. 459.

Selenium, 1–15 parts per million, was found in 12 of the 18 meteorites of various types examined. In troilite from Canyon Diablo 23 p.p.m.; in another sample 200 p.p.m. with S 37·22% (S/Se 4215); but none was found in the nickel-iron of this meteorite. L. J. S.

Buddhue (John Davis). *The average composition of meteoritic iron.* Pop. Astron. 1946, vol. 54, pp. 149–152.

The means of selected analyses of different types of meteorites are tabulated; only Fe and Ni show marked variation.

Group	H.	Ogg.	Og.	Om.	Of.	Off.	$D_1B.$	$D_2S.$
Ni %	5·57	6·54	7·39	8·22	9·00	11·65	10·63	6·88
Sp. gr.	7·727	7·714	7·394	7·673	7·708	7·733	7·299	7·643

The average Ni % in all siderites (327) is 9·10, in mesosiderites 8·52, and in the tal of chondrites 9·54. The fine octahedrites (Of) show two Ni maxima, 8·30 l 11·50, corresponding to medium and finest octahedrites. L. J. S.

DDHUE (John Davis). *Some meteoritic iron sulfides.* Pop. Astron., 1945, vol. 53, pp. 405–409.

A nodule in a Mukerop (Gibeon) siderite consists of two sharply separated terials. One is bronze-brown with dark grey streak, hard enough to take a d polish, strongly magnetic, and readily attacked by dilute HNO_3; analysis I, $_4S_5$. The other is nearly black with black streak, too soft to polish, non-gnetic, and resistant to dilute acid; anal. II, $Fe_{10}S_{11}$. The first seems to be inct from pyrrhotine (and presence of some pentlandite is suggested); the ond is close to troilite. Material from Canyon Diablo (III) and Xiquilpilco) is in both cases dark coloured, non-magnetic, and resistant to dilute acid; h are referred to troilite with a slight excess of iron. [M.A. 8–196, 197.]

	Fe.	Ni.	Co.	S.	P.	Total.	Insoluble.	Sp. gr.
I.	52·3	8·4	—	39·3	—	100·0	—	—
II.	61·2	nil	—	38·7	trace	99·9	—	—
III.	65·85	nil	nil	34·15	trace	100·00	16·33	4·445
IV.	60·75	3·42	n.d.	35·85	trace	100·02	3·74	4·910

L. J. S.

DDHUE (John Davies). *The formation of meteoritic iron oxide.* Pop. Astron., 1944, vol. 52, pp. 346–351, 1 fig.; Contr. Soc. Res. Meteorites, [1945], vol. 3 (for 1944), pp. 156–161, 1 fig.

Three types of iron rust are distinguished: coarsely lamellar, finely lamellar, d massive. The first two due to oxidation from the surface of the mass of iron, thickness of the lamellae depending on the rate of oxidation. The massive m, sometimes in the interior of the mass, is suggested to be due to electro-ic action between kamacite and taenite or between kamacite and schreibersite; to the cementation of lamellae by secondary deposition of iron hydroxide. powdery form, seen only on museum specimens, is due to the decomposition lawrencite. Analyses by F. G. Hawley: I, from Henbury, Central Australia; (also Cr_2O_3 0·02), Sardia, Georgia; III, Canyon Diablo, Arizona.

	Fe_2O_3.	FeO.	NiO.	CoO.	Cr_2O_3.	CaO.	P_2O_5.	SO_3.	H_2O+.	H_2O-.	insol.	Total.	Pt metals oz. per ton.
I.	73·86	6·68	5·51	0·49	—	0·30	0·25	0·42	10·25	1·92	0·20	99·88	0·28
II.	58·67	16·75	4·63	0·70	0·02	0·30	1·28	0·89	7·96	2·86	4·68	98·74	0·30
III.	77·55	7·58	5·83	0·37	—	—	0·43	0·20	6·15		0·90	99·01	0·07–0·73

L. J. S.

DDING (Assar). *Meteorsten fallen vid Hallingeberg.* Geol. För. Förh. Stockholm, 1944, vol. 66, p. 314.

A meteorite fell at 2 p.m. on February 1, 1944, at Hallingeberg [58° N., 16½° E.], km. NNW. of Västervik in Kalmar län, Sweden, making a crater-like hole cm. deep. Fragments with a total weight of 1456 grams (the largest 685) re collected. It is a grey chondrite poor in iron with a well-marked chondritic ucture. L. J. S.

Hadding (Assar). *We and the world outside. Geological aspects of the problem of meteorites.* (Lecture.) Kungl. Fysiograf. Sällsk. Lund Förh., 1941, vol. (for 1940), no. 4, pp. 37–51.

Zenzén (Nils). *Om den av fossilförande kalksten bestående s. k. Bleckenstadmeteoriten.—Über den aus fossilienführenden Kalkstein bestehenden s. Bleckenstadmeteorit.* Geol. För. Förh. Stockholm, 1942, vol. 64, pp. 61–7 2 figs. (German summary, pp. 76–77.)

Hadding (Assar). *Är Bleckenstadsstenen en meteorit?* Ibid., 1943, vol. 65, pp. 29. (German summary, pp. 28–29.)

Zenzén (Nils). *Bleckenstadsstenen är ingen meteorit.—Der Bleckenstad-Stein kein Meteorit.* Ibid., 1943, vol. 65, pp. 313–316. (German summary, p. 3

Hadding (Assar). *Die Observationen beim Fall des Steines von Bleckens* Ibid., 1943, vol. 65, pp. 316–317.

At 7.45 p.m. on 11 April 1925 a meteor was observed over eastern Östergötla which ended over Bleckenstad, leaving a trail of smoke. Stones are said to h fallen, and fragments of a white, porous, fossiliferous limestone ($CaCO_3$ 99 were picked up, different from any rock occurring in the neighbourhood. Zen shows the material to be calcined Cambrian limestone; while Hadding still ke an open mind that there may be other kinds of meteorites than those recognized. L. J. S.

Vogel (R.). *Emsland, ein neuer Eisenmeteorit.* Chemie der Erde, 1943, vol. pp. 52–65, 4 pls.

A siderite weighing 19 kg. was found in 1940 in a layer of sand in peat diggin near the village of Brahe on the Ems (53° 6′ N., 7° 12′ E.). The surface is fres and smooth; one side, parallel to an octahedral face, shows Widmanstett figures, evidently due to etching by humic acids; the opposite side is pitted. is a medium octahedrite with schreibersite and rhabdite. The surface heati zone, 1–3 mm. thick, shows granulated kamacite and fused schreibersite. Analys by H. Schultz, Fe 90·10, Ni 8·71, Co 0·78, Cr 0·012, Mn trace, Mg 0·016, P 0·26 S 0·007, Si 0·006, C 0·05. L. J. S.

Galle (J. G.) (1812–1910). *Concerning the meteor observed on January 30, 186 which fell thru the atmosphere as a shower of stones at Pultusk in the kingdom Poland.* Translated by Walter H. Haas. Pop. Astron., 1944, vol. 52, pp. 43–4 94–98; Contr. Soc. Res. Meteorites, [1945], vol. 3 (for 1944), pp. 124–133.

Continuation [M.A. **8**–373]. L. J. S.

Vernadsky (V. I.) Вернадский (В. И.). Несколько соображений о проблема метеоритики.—*Some considerations of the problems of the meteoritics.* Ме оритика, Акад. Наук СССР (Meteoritica, Acad. Sci. USSR), 1941, vol. pp. 3–11 (Russian), pp. 13–22 (English).

This is an introductory note to a new periodical issued by the Meteori Committee of the Academy of Sciences; it is edited by V. I. Vernadsky. Su gested lines of research are: galactic source of meteorites, cosmic dust, isotop composition, radioactivity, presence of water and organic substances. Of t 91 known falls and finds in the Soviet Union, 79 are represented in the Academ collection. In all, 145 meteorites are represented in the collection. L. J. S.

ULOV (N. S.) & BRYUKHATOV (N. L.)] Акулов (Н. С.) и Брюхатов (Н. Л.) AKULOV (N. S.) and BRÜKHATOV (N. L.). Магнитные методы исследования структуры железных метеоритов.—*Magnetic methods for the study of the structure of iron meteorites.* Метеоритика, Акад. Наук СССР (Meteoritica, Acad. Sci. USSR), 1941, vol. 1, pp. 23–30 (Russian), pp. 30–31 (English summary), 16 pls., 6 text-figs.

he Boguslavka meteorite [hexahedrite, fell 1916, Siberia] is a single crystal n strong magnetic anisotropy, corresponding to a body-centred cubic lattice; is confirmed by X-ray Laue photographs. Crocus powder in spirit is painted the polished surface and allowed to evaporate in a weak magnetic field pendicular to the surface. This 'magnetic suspension method' shows three es of structure: a granular structure at the exterior of the mass, followed by mellar structure, and at a depth of 2 cm. a uniform coarse block structure. surface disturbance of the structure indicates sharp temperature gradients ing the passage of the meteorite through the earth's atmosphere. Many tomicrographs (× 210) show the structure of the iron with prominent mann lines. L. J. S.

OLAROVICH (M. P.) & LEONTIEVA (A. A.)] Воларович (М. П.) и Леонтьева (А. А.) VOLAROVITCH (M. P.) and LEONTIEVA (A. A.). Исследование вязкости метеоритов и тектитов.—*A study of the viscosity of meteorites* [*and tektites*]. Метеоритика, Акад. Наук СССР (Meteoritica, Acad. Sci. USSR), 1941, vol. 1, pp. 33–41 (Russian), p. 42 (English summary), 5 figs.

he complete paper of which an abstract has been previously given. [M.A. 72.] L. J. S.

AVERT (P. L.) Драверт (П. Л.). О находке каменного метеорита Ерофеевка.—*On the finding of the Erofeevka stony meteorite.* Метеоритика, Акад. Наук СССР (Meteoritica, Acad. Sci. USSR), 1941, vol. 1, pp. 43–46 (Russian), pp. 46–47 (English summary), 1 pl., 1 text-fig. (map).

Note previously published [M.A. 7–67]. In this volume L. A. Kulik (tom. cit., 89–90, pl. IV, fig. 17) describes the stone as a black crystalline chondrite. L. J. S.

AVERT (P. L.) Драверт (П. Л.). О находке каменного метеорита Хмелевка, упавшего 1. III. 1929 г.—*On the finding of the Khmelevka* [*stony*] *meteorite, which fell on March 1, 1929.* Метеоритика, Акад. Наук СССР (Meteoritica, Acad. Sci. USSR), 1941, vol. 1, pp. 49–53 (Russian), p. 53 (English summary), 1 fig. (map).

A large and brilliant fireball with loud detonations was observed at 5.30 a.m. March 1, 1929, and during mowing in the following July several (5–6) stones re found near the village Khmelevka (56° 45′ N., 75° 20′ E.), Tara district, est Siberia. Only a portion (6150 grams) of one stone has been recovered. A. Kulik (tom. cit., pp. 117–118, 122–123, pl. XVII, fig. 50) describes it as grey crystalline chondrite, and the name is transliterated as 'Hmeljovka'. crometric analysis by P. N. Chirvinsky gave silicates 91·33, nickel-iron 2·38, bilite 5·82, chromite 0·41 %. L. J. S.

Kupletsky (B. M.) Куплетский (Б. М.). Материалы к микроскопии метеори... СССР. 1. Каменный метеорит Первомайский Поселок.—*Materials on ... microscopis* [sic] *study of the meteorites of the USSR. 1. A stony mete... Pervomaysky Poselok.* Метеоритика, Акад. Наук СССР (Meteoritica, A... Sci. USSR), 1941, vol. 1, pp. 55–57 (Russian with English summary), ...

This meteorite [M.A. 7–62] is an enstatite-achondrite of the aubrite (Bu... group and shows a black zone of cataclastic structure. Micrometric ana... gave enstatite 87·91, maskelynite 5·94, nickel-iron 2·97, troilite 2·95, chro... 0·33 %. L. A. Kulik (tom. cit., pp. 104–112, 122–123, pl. XIII, 1 map in t... classes it as a grey-black veined crystalline enstatite-chondrite (not an achondr...

L. J. ...

Kupletsky (B. M.) & Ostrovsky (I. A.) Куплетский (Б. М.) и Остров... (И. А.). Материалы к микроскопии метеоритов СССР. 2. Камен... метеорит Старое Песьяное.—*Materials on the microscopic study of ... meteorites of the USSR. 2. A stony meteorite Staroie Pesianoie.* Метеорит... Акад. Наук СССР (Meteoritica, Acad. Sci. USSR), 1941, vol. 1, pp. 5... (Russian with English summary), 2 figs.

This meteorite (3085 grams) fell at 6 a.m. (or 5.10) on 2 October 1933 in ... village Staroe Pesyanoe (55° 30′ N., 66° 5′ E.), near Kurgan, West Siberia. It... an enstatite-achondrite. Micrometric analyses gave enstatite (2V 55°, positi... corresponding with an absence of $FeSiO_3$) 90 %, olivine (2V 87°, positi... corresponding with 20 % Fe_2SiO_4) 5 %, albite 3 %, troilite and magnetite 2 ... It was listed by I. S. Astapovich [M.A. 7–172], and is further described by L. ... Kulik (tom. cit., pp. 114–116, 122–123, pl. XVI, 2 text-figs., map). Oth... variations in spelling are Staroje Pesjanoje, Staro-Pesiianoe, i.e. Old Pesyano...

L. J. S.

Selivanov (L. S.) Селиванов (Л. С.). О падении каменного метеорита Каинсаз. ... [*Fall of*] *a stony meteorite Kainsaz.* Метеоритика, Акад. Наук СС... (Meteoritica, Acad. Sci. USSR), 1941, vol. 1, pp. 63–69 (Russian with Engli... summary), 1 pl., 3 text-figs.

Sytinskaya (N. N.) Сытинская (Н. Н.) Sitinskaja (N. N.). Элементы орби... метеорита Каинсаз. [*Elements of the orbit of the meteorite Kainsaz.*] Ibi... p. 71 (Russian).

Fuller details of a paper previously published [M.A. 7–270, 271]. L. A. Kul... (tom. cit., pp. 95–96, 122–123, pls. V–VII) classes the stone as a grey spheri... chondrite.

L. J. S.

Kulik (L. A.) Кулик (Л. А.). Прирост коллекции Метеоритов Академ... Наук СССР в Москве с 1934 по 1939 г.—*Meteorite collection of the Acade... of Science of USSR. Augmentation between the years 1934 and 1939 ... Moscow.* Метеоритика, Акад. Наук СССР (Meteoritica, Acad. Sci. USSR... 1941, vol. 1, pp. 73–121 (Russian), 122–123 (list in English), 18 pls., 7 tex... figs.

Collected information, together with some new data, is given for the followi... 29 meteorites of USSR, several of them new falls or finds, and now preserve...

he collection of the Academy of Sciences. The weights quoted are those of erial in the collection. *Alexandrovsky* (Александровский Хутор, i.e. Alexrovsky farm), fell July 7, 1900, 50° 57′ N., 31° 49′ E., grey-veined chondrite, 1 grams [M.A. **2**–257]. *Berdyansk* (Бердянск), known 1878, 46° 45′ N., 36° E., black crystalline veined chondrite, 2080 grams. *Brahin* (Брагин, Bragin), 30′ N., 30° 20′ E. [M.A. **2**–84, 258; **3**–255; **4**–260, 420]. *Brient* (Бриент), fell 21 h., April 19, 1933, 52° 8′ N., 59° 19′ E., achondrite, 223 grams. *Erofeevka* офеевка), black crystalline chondrite, 1771·9 grams [M.A. **7**–67]. *Grosslie-hal* (Гросслибенталь), fell November 19, 1881, 46° 21′ N., 30° 35′ E., white-ied hypersthene-chondrite, 6629 grams. *Ichkala* (Ичкала), fell 11 h. 34 m., 29, 1936, 58° 12′ N., 82° 56′ E., grey spherical chondrite, 4031 grams. *nsaz* (Каинсаз), grey spherical chondrite, 102,686 grams [M.A. **7**–270, 271]. *ital-Aryk* (Каптал-Арык), intermediate spherical veined chondrite, 2905 ms [M.A. **7**–270, 271]. *Karagai* (Карагай), found since 1900, 54° 7′ N., 59° E., white chondrite, 115 grams. *Kashin* (Кашин, Kašin) = Glazatovo затово), 57° 21′ N., 37° 37′ E., grey-veined chondrite, 123 grams [M.A. 58; **3**–254, 255; **4**–119]. *Khmelevka* (Хмелевка, Hmeljovka), 56° 45′ N., 75° E., grey crystalline chondrite, 6019 grams. *Lavrentievka* (Лаврентьевка), 27′ N., 51° 34′ E., white chondrite, 1045 grams [M.A. **7**–270, 271, 541]. *igei* (Мигеи, Mihei), fell June 18, 1889, 48° 4′ N., 30° 58′ E., carbonaceous ndrite, 2688 grams. *Mordvinovka* (Мордвиновка) = Pavlograd, fell May 19, 6, 48° 32′ N., 35° 59′ E., white chondrite, 29,615 grams. *Nikolaevka* иколаевка), fell 3 h., July 11, 1935, 52° 27′ N., 78° 38′ E., grey spherical ndrite, 4020 grams. *Novorybinskoe* (Новорыбинское), coarse octahedrite, 9 grams [M.A. **7**–374, 541]. *Padvarninkai* (Падварнинкай), sherghottite, 63 ms [M.A. **4**–419, 420; **5**–9; **6**–392]. *Pavlodar* (stone) (Павлодар), fell 13 h. m., May 23, 1938, 52° 18′ N., 77° 2′ E., white chondrite, 37 grams [M.A. 71, 541]. *Pavlovka* (Павловка), fell 1882, 52° 2′ N., 40° 54′ E., howardite, 5 ms. *Pervomaisky* (Первомайский Поселок, i.e. Pervomaisky hamlet), fell h., December 26, 1933, 56° 38′ N., 39° 26′ E., grey-black veined crystalline tatite-chondrite, 48,976 grams [M.A. **7**–62, **9**–294]. *Savchenskoe* (Савченское, čenskoje), fell 20–21 h., July 27, 1894, 47° 13′ N., 29° 52′ E., intermediate erical crystalline chondrite, 2174 grams. *Staroe Pesyanoe* (Старое Песьяное), tatite-chondrite, 3085 grams [M.A. **9**–294]. *Sungach* (Сунгач), fell 7 h. 30 m., ril 10, 1935, 44° 52′ N., 133° 10′ E., grey-veined chondrite, 635 grams. *vilovka* (Вавиловка), fell 14 h., June 19, 1876, 46° 9′ N., 32° 50′ E., amphoterite dite), 1374 grams. *Veliko-Nikolaevsky* mine (Велико-Николаевский Прииск), oarse octahedrite, 24,267 grams, was found in the Academy collection labelled ryusa' (Бирюса); it had been mentioned by Y. A. Markov in 1902 as being m the Great Nikolaevsky mine (53° 50′ N., 97° 20′ E.) on the Khoma tributary the Biryusa river, Nizhne Udansk district, Irkutsk. *Yurtuk* (Юртук, tuk), 47° 19′ N., 35° 22′ E., amphoterite, 1472 grams [M.A. **7**–175]. *Zhmeni* мени, Žmeni), fell 1858, 51° 50′ N., 20° 50′ E., howardite, 31 grams. *Zhovt-yi* ((Жовтневый Хутор, Žovtnevyj Hutor, i.e. Zhovtnevyi farm, Jovtnevy), ermediate veined chondrite, 27,844 grams [M.A. **7**–271, 373, 541; **9**–296]. vit' (*Ливит*) is given incorrectly as a name for the silica-glass from the yan Desert.

L. J. S.

Krinov (E. L.) Кринов (Е. Л.). Дождь каменных метеоритов, выпавш[ий] 9 X 1938 г. в хуторе Жовтневом. (Исследование условий движени[я] выпадения).—*The meteorite "rainfall" at the Žovtnevy hutor on the 9th October, 1938. (Investigation of the movement and fall.)* Метеоритика, Ак[ад.] Наук СССР (Meteoritica, Acad. Sci. USSR), 1941, vol. 2, pp. 11–57 (Russian) 57–59 (English summary), 14 pls., 16 text-figs.

Further details on the fall of the Zhovtnevyi shower of stones [M.A. **7**–[2]73, 541]. The orange-red fireball, with an initial geocentric velocity of 26 [km.] per second (heliocentric velocity 33 km./sec.), was first observed at a height [of] 124 km. and there were explosions at heights of 12·7 and 7·6 km. Eight ston[es] and many fragments with a total weight of about 90 kg. have been found. T[hey] show primary and secondary crusts, and fitting the pieces together the origi[nal] weight is estimated at 195 kg. L. J. S.

Dravert (P. L.) Драверт (П. Л.). О падении каменного метеорита Кузнецово. *A stony meteorite Kuznetzovo (fell May 26, 1932).* Метеоритика, Акад. Н[аук] СССР (Meteoritica, Acad. Sci. USSR), 1941, vol. 2, pp. 61–64 (Russian) p. 65 (English summary), 1 fig. (map).

Repetition of a previous paper [Min. Mag. **23**–509]. The stone is classed as [an] intermediate chondrite. L. J. S.

Ivanov (L. L.) Иванов (Л. Л.). Каменный Метеорит Юртук. (Химик[о]-микроскопическое исследование).—*The stony meteorite Yurtuk. (A chemico-microscopical study.)* Метеоритика, Акад. Наук СССР (Meteoritica, Acad. Sci. USSR), 1941, vol. 2, pp. 67–73 (Russian), 73–74 (English summary).

Fuller account of a paper previously published [M.A. **7**–175]. No nickel present in this achondrite. L. J. S.

Kupletsky (B. M.) Куплетский (Б. М.). Материалы к микроскопическому исследованию метеоритов СССР.—*Materials on the microscopical study of the meteorites of the USSR. The Saratov stone meteorite.* Метеоритика, Акад. Наук СССР (Meteoritica, Acad. Sci. USSR), 1941, vol. 2, pp. 75–80 (Russian) p. 81 (English summary), 3 pls., 7 text-figs. [Nos. 1 and 2, M.A. **9**–294.]

Micrometric measurements gave the following volume % of the constituents: (3) *Kaptal-Aryk*, olivine 51·2, pyroxene 34·0, felspar 2·4, troilite 5·8, nickel-iron 5·5, chromite 1·1. (4) *Pavlodar*, olivine 40·0, bronzite 39·4, nickel-iron 18·[1], troilite 2·1. (5) *Lavrentievka*, olivine (2V 88–89°, negative, corresponding with 16 % Fe_2SiO_4) and pyroxene (2V 86–87°, negative, 16 % $FeSiO_3$) 14·15, troilite 16·49, nickel-iron 7·55, chromite 0·48. Six types of olivine and bronzite chondrules are distinguished. (5) *Saratov* (fell 1918), chondrite with dark-brown groundmass, olivine (2V 86°, negative, 2 % Fe_2SiO_4) 27·5 (25·5), bronzite (11–23 % $FeSiO_3$) 31·2 (27·4), ores 18·2 (21·6), groundmass 23·1 (25·5). Eight types of chondrules are distinguished. L. J. S.

[Chirvinsky (P. N.)] Чирвинский (П. Н.) Tschirwinsky (P. N.). Микроскопическое исследование метеорита Хмелевка падения 1 марта 1929 г.—*Microscopische Untersuchung des Meteoriten Chmelewka, gefallen am 1sten März des Jahres 1929.* Метеоритика, Акад. Наук СССР (Meteoritica, Acad. Sci. USSR), 1941, vol. 2, pp. 83–92 (Russian), p. 92 (German summary), 4 figs.

Micrometric measurements of the Khmelevka meteorite (6150 grams), Wes[t]

teria, gave the volume composition: pyroxene and olivine 91·33, nickel-iron 3, pyrrhotine 5·82, chromite 0·41, merrillite 0·06 %, and very little anorthite. the olivine 2V 76°, negative, corresponding with $2Mg_2SiO_4.3Fe_2SiO_4$ (the n composition of olivine of chondrites being $5Mg_2SiO_4.2Fe_2SiO_4$). One doubt- grain has some of the characters of amphibole (which has not been recognized n meteoritic mineral). L. J. S.

IRVINSKY (P. N.)] Чирвинский (П. Н.) TSCHIRWINSKY (P. N.). Система пироксен-плагиоклаз в эвкритах и говардитах с физико-химической точки зрения.—*The system of pyroxene-plagioclase in eucrites and hovardites from physico-chemical view-point.* Метеоритика, Акад. Наук СССР (Meteoritica, Acad. Sci. USSR), 1941, vol. 2, pp. 93–101 (Russian), p. 102 (English summary).

The mean of 19 analyses of eucrites and howardites is: SiO_2 49·01, TiO_2 0·25, O_3 10·88, Cr_2O_3 0·28, Fe_2O_3 0·98, FeO 16·84, MnO 0·35, MgO 10·27, CaO 9·35, $_2O$ 0·78, K_2O 0·39, H_2O 0·07, P_2O_5 0·04, S 0·11, Fe 0·12 Fe (metal) 0·05 = 77, mean sp. gr. 3·24 (limits 3·05–3·39). The average mineralogical composi- n is: pyroxene 65·24, bytownite 33·47, accessory minerals 1·29 %, which is sibly a eutectic mixture. Plagioclase ranges An_{44-99} (mean An_{75}). Calculated nposition of the pyroxene is: SiO_2 51·42, FeO 25·82, MnO 0·54, MgO 15·74, O 6·48 %, corresponding to pigeonite. A classification of these meteorites is sed on the composition of the felspar and the ratio CaO : MgO. L. J. S.

RINOV (E. L.) Кринов (Е. Л.). Краткий каталог Метеоритов СССР (на 1 июля 1945 г.).—*Short catalogue of the USSR meteorites.* Астрономический Журнал (Astronomical Journal of the Soviet Union), 1945, vol. 22, no. 5, pp. 303–311, 6 figs. (English summary, p. 310).

An alphabetical list of 113 meteorites of the Soviet Union gives their names in ussian and English, classification symbol, date, latitude and longitude, number specimens, total weight, and in which museum the main mass is preserved. lls include 3 irons and 72 stones, and finds include 23 irons, 5 stony irons, and stones. The positions of finds are plotted on a map, and photographs are produced of the Kainsaz, Nikolaeva, Perovomaisky Poselok, Timokhina, and ebankol meteorites. L. J. S.

HOSH (P. K.). *The Bherai (Kathiawar) meteorite.* Rec. Geol. Surv. India, 1941, vol. 75 (for 1940), Prof. Paper no. 14, 22 pp., 4 pls. Price *As.* 12 = 1*s.*

Of this small meteorite (fell April 28, 1893) only two fragments have been eserved (17½ grams in the British Museum, and 8·51 grams, sp. gr. 3·55. in the dian Museum). It is a veined white hypersthene-olivine-chondrite. The icroscopical characters of polished and thin sections are described in detail. icrometric analysis gave oligoclase and maskelynite 10·80, olivine (predomi- ting) and hypersthene 72·50, nickel-iron 8·50, troilite 7·20, chromite 1·05, haema- te (?) 0·15, merrillite (or apatite) trace, copper trace = 100·20 weight %. The ivine has 2V 76–88°, negative, the average value corresponding with Mg/Fe = 80; and the hypersthene 2V 63–73°, negative, average Mg/Fe = 2·36. Three nes in the scoriaceous crust (0·9–2 mm. thick) are distinguished. The outer- ost zone of opaque glass contains minute laths of olivine and hypersthene in

aggregates with a general resemblance to chondrules, which are called 'micr... chondrites' [i.e. microchondrules]. L. J. S.

Khan (Mohd. A. R.). *A siderite of the fourteenth century.* Nature, London, 19... vol. 154, p. 465.

In Ibn Battúta, 'Travels in Asia and Africa 1325–1354', translated by H. A. R. Gibb (London, 1929, p. 134) mention is made of a black 'stone . . . very hard a... with a glitter on it', weighing about a hundredweight, which fell from the s... outside the town of Birgí (the ancient Pyrgion) near Ephesus in Asia Mino... This may perhaps have some connexion with a Turkish sword made of meteor... iron now in the meteorite collection in Moscow. L. J. S.

Detrice (H. J.). *The fall of the Pantar, Lanao, Philippine Islands, aerolite.* Pop. Astron., 1946, vol. 54, pp. 191–193.

A graphic account is given of a fireball with detonations observed at 8.45 a.m. on June 16, 1938, on Mindanao island. Sixteen stones were recovered from j... below the surface to depths of 20 inches. Thousands 'as big as corn and ri... grains' fell like hail on iron-roofed buildings. L. J. S.

[Krinov (E. L.)] Кринов (Е. Л.). Неизвестный железный метеорит *El Qoseir*. Доклады Акад. Наук СССР, 1945, vol. 47, pp. 515–517, 2 figs.

Krinov (E. L.). *An undescribed iron meteorite El Qoseir.* Compt. Rend... (Doklady) Acad. Sci. URSS, 1945, vol. 47, pp. 497–499, 2 figs.

A meteorite weighing 2405 grams was picked up in 1921 on the surface 15 km... south of Quseir = Kosseir (26° 17′ N., 34° 15′ E.) on the Red Sea coast of Egypt... It is an ataxite with Ni 15·17, Co 0·92, Cu 0·32 %, sp. gr. 7·783, and shows... indications of orientation in flight. L. J. S.

Hodge-Smith (T.). *A shower of meteoritic stones at Forest Vale, New South Wales.* Australian Journ. Sci., 1943, vol. 5, pp. 154–156, 1 fig.

At 3 p.m. on August 7, 1942, stones were observed to fall at Forest Vale (33° 21′ S., 146° 51½′ E.), and from Condobolin (35 miles to the NE.) about six puffs of reddish-brown smoke were seen at an estimated height of about 20 miles and 6 miles east of the point of fall. Five fragments were collected which fitted together to form an almost complete stone, the largest weighing 10·489 kg. and the whole about 26 kg. Another stone of 1·9 kg. was found 12 chains distant. A third stone said to have been found was broken up. They are chondritic stones with about 20 % of finely divided nickel-iron. L. J. S.

Edwards (A. B.) & Baker (G.). *The Koraleigh stony meteorite.* Mem. National Mus. Melbourne, 1943, no. 13, pp. 157–160.

A weathered stone weighing 450 grams was ploughed up in 1943 near Koraleigh [35° 6′ S., 143° 24′ E.] in New South Wales, 20 miles NW. of Swan Hill in Victoria. It is a bronzite-olivine chondrite, sp. gr. 3·41, with 9·7 % pyrrhotine+nickel-iron and small amounts of monoclinic pyroxene, merrillite, chromite, and glass. It is very similar to the Caroline meteorite [M.A. 8–197] which was found on the site of a blackfellows' camp and may have been transported, possibly belonging to the same fall. L. J. S.

ARDS (A. B.) & BAKER (G.). *The Cranbourne meteorites.* Mem. National Mus. Victoria, 1944, no. 14, pp. 23–35, 1 pl., 1 text-fig. (map).

me corrections are given for the recorded weights: Cranbourne no. 1, d 1854, $3\frac{1}{2}$ tons; no. 2, found 1854, $1\frac{1}{2}$ tons; no. 3, found between 1854 and , 15 lb., lost; no. 4, found 1923, $1\frac{1}{4}$ ton; no. 5, found 1923, 7 cwt.; no. 6, nham [M.A. **8**–377], found 1928, 89 lb.; no. 7, found 1923, 3 cwt.; no. 8, d 1923, 52 lb.; no. 9, Beaconsfield, found 1876, 165 lb.; no. 10, Langwarrin, d 1886, 18 cwt.; [total $7\frac{3}{4}$ tons, but in the paper 'exceeding 10 tons']. They found along a straight line (the Pakenham mass slightly off the line) 13 miles ngth extending from Langwarrin in the SW. to Beaconsfield in the NE. her details are given of nos. 4, 5, 7, and 8, found close to the site of no. 1 in wood parish near the SW. end of the line; they show the same coarse octa- al structure as the other masses, and the constituents are those previously ibed for the Pakenham mass; analyses (4, 5, 7 by A. B. Edwards, 8 by F. F.) gave:

	Fe.	Ni.	Co.	P.	S.	Cl.	insol.	Total.	Sp. gr.	Fe/Ni.
4	92·38	6·87	0·49	0·21	nil	n.d.	trace	99·95	7·5	13·4
5	92·33	6·78	0·53	0·19	nil	n.d.	nil	99·83	8·12	13·6
7	92·81	6·51	0·55	0·24	nil	n.d.	nil	100·11	7·98	14·3
8	92·80	6·89	nil	—	—	—	0·12	99·81	7·64	13·5
8 (scale) ...	55·59	3·96	nil	0·31	0·35	trace	12·58	73·16*	—	14·0

* including C 0·37.

he rapid decomposition of all the masses is suggested to be due to the presence hlorides absorbed from the marshy saline soil. L. J. S.

OWELL (G. F.) & FENNER (Chas.). *The Kybunga daylight meteor.* Proc. Roy. Geogr. Soc. Australasia, South Australian Branch, 1944, vol. 44 (for 1942–43), reprint 14 pp., 1 pl., 4 text-figs.

brilliant fireball was observed over a wide area north of Adelaide at 4.30 p.m. September 7, 1941. The place of fall is calculated to be near Kybunga ° 54′ S., 138° 30′ E.) where fragments were heard to fall, but none has yet n found amongst the growing crops. Estimated from a photograph taken at istance of 80 miles 'the incandescent pear-shaped object was 2·25 miles long', 5–0·90 mile wide, and 0·82 cubic mile. The heights of several explosions are culated as $6\frac{3}{4}$ and $5\frac{1}{2}$ miles. L. J. S.

GOUGH (P. J.). *References on the early history of the Tucson, Arizona, meteorites: the "Irwin-Ainsa" and "Carleton" irons.* Pop. Astron., 1943, vol. 51, pp. 511–518, 563–567, 2 figs.; Contr. Soc. Res. Meteorites [1944], vol. 3 (for 1943), pp. 108–119, 2 figs.

— *Further references on the early history of the Tucson, Arizona, meteorites.* Ibid., 1944, vol. 52, pp. 243–247; ibid., [1945], vol. 3 (for 1944), pp. 143–147.

Quotations are given from 24 references dated between 1850 and 1876 respecting siderites 'Signet' or 'Irwin-Ainsa' (688 kg.) and 'Carleton' (287 kg.). Both sses are now in the United States National Museum in Washington, D.C., latter having been transferred from California in 1941. [Min. Mag. **9**–16.] L. J. S.

Leonard (Frederick C.). *The identity of the "Windmill Station" with the "Valley Wells", California, aerolitic fall.* Pop. Astron., 1944, vol. 52, pp. 513–51[illegible] Contr. Soc. Res. Meteorites, [1945], vol. 3 (for 1944), pp. 174–175.

Four small weathered fragments were picked up in 1929 on the desert ½ [illegible] north of Valley Wells (35° 28′ N., 115° 40′ W.), San Bernardino County. W[illegible] mill Station is a mile or so to the south. L. J. S.

Nininger (H. H.). *The Eaton, Colorado, meteorite: introducing a new type.* P[illegible] Astron., 1943, vol. 51, pp. 273–280, 3 figs.; Contr. Soc. Res. Meteori[illegible] [1944], vol. 3 (for 1943), pp. 85–92, 3 figs.

A coppery nugget is reported to have been observed to fall in May 193[illegible] Eaton, Weld Co. It has an irregular elongated shape 2½ inches long and we[illegible] 29·547 grams. The presence of native copper in the Garnett (Kansas) meteo[illegible] [M.A. 8–193] is considered to be some support to it being of meteoritic ori[illegible] No analysis is given, but a new 'copper-zinc-lead group' of meteorites is sugges[illegible] L. J. S.

Wilson (Ben Hur). *The Mapleton meteorite.* Pop. Astron., 1944, vol. 52, pp. 3[illegible] 399, 2 figs.

A siderite weighing 108 lb. (49 kg.) was found in 1939 while ploughing ne[illegible] Mapleton (42° 11′ N., 95° 43′ W.), Monona Co., Iowa. It has the structure of [illegible] medium octahedrite. Analysis by H. Herpers gave Fe 92·16, Ni 7·61, Co 0·[illegible] Cu 0·003, C 0·14, S 0·01, P 0·10, Cl nil, sp. gr. 7·70. Preliminary notes, stati[illegible] that the whole mass had been acquired by the Chicago Natural History Museu[illegible] appeared in Field Museum News, 1939, vol. 10, no. 9, p. 4, and in Rocks a[illegible] Minerals, Peekskill, N. Y., 1939, vol. 14, p. 320. L. J. S.

Nininger (H. H.). *Finding a new meteorite.* Pop. Astron., 1944, vol. 52, pp. 4[illegible] 43; Contr. Soc. Res. Meteorites, [1945], vol. 3 (for 1944), pp. 123–124.

A rusty stone weighing about 4 lb. was found in a farmyard in Cowley C[illegible] Kansas. The circumstances of some of the author's previous finds are al[illegible] mentioned. With a magnetic rake many thousand fragments of meteoritic iro[illegible] were collected at the craters of Canyon Diablo in Arizona and Odessa in Texa[illegible] [M.A. 8–371.] L. J. S.

Cecil (Francis D.). *The St. Mary's meteorite of 1919.* Sky and Telescope (Harva[illegible] College Observatory), 1944, vol. 3, no. 12, p. 9, 1 fig.

A fireball was observed in the summer of 1919 [6 p.m., June 20], and a ston[illegible] fell near Ridge [38° 10′ N., 76° 23′ W.], St. Mary's Co., Maryland. Most [illegible] believed to have fallen in Chesapeake Bay. Only a small fragment, 24·25 gram[illegible] has been preserved; this is in the Maryland Academy of Sciences at Baltimor[illegible] It is dark-grey with numerous chondrules and consists of enstatite and olivi[illegible] with little metal; sp. gr. 3·24. L. J. S.

Perry (Stuart H.). *Note on the Fairplay, Missouri, iron.* Pop. Astron., 194[illegible] vol. 54, p. 49.

This mass, which has been listed as a doubtful meteorite, is white cast iro[illegible] with pearlite and ferrite. L. J. S.

NARD (Frederick C.). *The co-ordinate numbers and classification of the Quartz Mountain and Quinn Canyon, Nevada, siderites.* Pop. Astron., 1944, vol. 52, pp. 512–513; Contr. Soc. Res. Meteorites, [1945], vol. 3 (for 1944), pp. 173–174.

or the Quartz Mountain meteorite, [M.A. **6**–397] the co-ordinate number is 7,372 [i.e. lat. 37·2°, long. 116·7°] and for Quinn Canyon (found 1908) 1154,381. width of the kamacite bands are $\frac{3}{4}$–$2\frac{1}{2}$ mm. and $1\frac{1}{2}$–2 mm. respectively, so that are coarse, rather than medium, octahedrites. Quinn Canyon has the appearof a very old meteorite, and is very similar to Canyon Diablo. L. J. S.

INGER (H. H.). *The Puente-Ladron, Socorro County, New Mexico, meteorite.* Pop. Astron., 1944, vol. 52, pp. 407–410, 1 fig.; Contr. Soc. Res. Meteorites, [1945], vol. 3 (for 1944), pp. 165–167, 1 fig.

chondritic stone weighing 7·673 grams was picked up in 1944 on the surface to a bridge (puente in Spanish) over the Rio Puerco, 34° 24′ N., 106° 51′ W., miles from Ladron Peak. Search for other stones in the neighbourhood is gested. L. J. S.

PAZ (Lincoln). *A remark on the Puente-Ladron, New Mexico, aerolite.* Pop. Astron., 1946, vol. 54, pp. 95–96.

TH (Claude H.). *Further remarks on the Puente-Ladron, New Mexico, aerolite.* Ibid., 1946, vol. 54, pp. 193–195.

his stone was no doubt part of a shower, but having been found on an ancient ian main highway it may have been transported. L. J. S.

TH (E. A.). *The train of the Richardton, North Dakota, aerolite, June 30, 1918.* Pop. Astron., 1945, vol. 53, pp. 241–244, 3 figs.

straight trail of light, which persisted for $\frac{1}{2}$ hour, was seen at 11.45 p.m. ntral summer time). It began at a height of 18 miles and ended with detonans at a height of 11 miles, the length of the path being 15 miles and the width mile. Smaller fragments fell almost vertically sideways from the line of path, the larger fragments carried farther. [M.A. **1**–101.] L. J. S.

NDERSON (E. P.) & PERRY (S. H.). *New Westville, Preble county, Ohio, meteorite.* Smithsonian Miscell. Collect., 1946, vol. 104, no. 17, 9 pp., 4 pls., 1 text-fig.

A weathered mass of 4·8 kg. was found in 1941 at 39° 48′ N., 84° 49′ W. It is a dium-fine octahedrite with prominent taenite. Analysis gave Fe 89·77, Ni 9·41, 0·61, P 0·10, insol. 0·07. The taenite gave Ni 26·13, Co 0·95, P nil, insol. 0·46, gr. 7·46–7·85. The composition and temperature of formation are discussed relation to the Fe–Ni equilibrium diagram, and the structure of the plessite is scribed. L. J. S.

NDSEY (*Mrs.* W. J.). *Cavour meteorites.* Mineralogist, Portland, Oregon, 1943, vol. 11, p. 316, 1 fig.; 1944, vol. 12, p. 388, 1 fig. Reprinted under the titles *The Cavour, South Dakota, siderites: a newly reported meteorite*, and *Four more Cavour, South Dakota, siderites*, in Pop. Astron., 1943, vol. 51, pp. 567–568; 1945, vol. 53, pp. 40–41; Contr. Soc. Res. Meteorites, [1944], vol. 3 (for 1943), pp. 119–120.

A dark-brown mass (8 lb.) of iron with 'thumb marks' was found several years

ago on a farm 11 miles SW. of Cavour [44° 25′ N., 98° 2′ W.]. In 1941 and 19[illegible] two other similar masses weighing 8 lb. 6 oz. and 9 lb. were found near by. Th[illegible] of the four masses found later weigh 12½, 8, and 1 lb. L. J. S.

Buckstaff (Ralph N.). *A new Wisconsin meteorite.* Trans. Wisconsin Acad. Sc[illegible] Arts. Lett., 1943, vol. 35, pp. 99–103, 1 pl., 1 text-fig.

A siderite weighing 32 lb. 11¼ oz. [14·8 kg.] was ploughed up in 1916 at Angel[illegible] Shawano County, 44° 15′ N., 88° 15′ W. It is a coarse octahedrite and sho[illegible] Neumann lines in the 1–2 mm. bands of kamacite. Analysis by E. J. Schnei[illegible] gave Fe 95·5, Ni 4·5, Mn 0·5 %. L. J. S.

Herrero Ducloux (Enrique). *Nota sobre el hierro meteórico de Ñorquín (go[illegible] nación del Neuquén).* Notas Museo La Plata, 1945, vol. 10, Geol. no. [illegible] pp. 163–164, 3 pls.

This siderite, weighing 19¼ kg., found [date ?] at Ñorquín [37° 43′ S., 70° 48′ W.] is a medium to coarse octahedrite with some troilite, schreibersite, graphite, an[illegible] crystals of olivine. Analyses of a fragment (and turnings) gave Fe 93·542 (93·166) Ni 4·513 (4·529), Co 0·570 (0·560), Sn 0·052 (0·040), S 0·011 (0·009), P 0·162 (0·158) C graphite 0·177 (0·160), siliceous residue 0·953 (1·078), traces of Ti, Mn, C[illegible] sp. gr. 7·651 (7·721). L. J. S.

Herrero Ducloux (Enrique). *Nota sobre el meteorito de Tostado (provincia [illegible] Santa Fe).* Notas Museo La Plata, 1945, vol. 10, Geol. no. 41, pp. 165–16[illegible] 2 pls.

This dark-brown stone weighing 22 kg. was found [date ?] while ploughing a[illegible] Tostado [29° 14′ S., 61° 55′ W.]. Analysis gave SiO_2 36·72, TiO_2 trace, Al_2O_3 3·7[illegible] Cr_2O_3 0·44, Fe_2O_3 6·05, FeO 10·11, MnO 0·51, NiO 1·64, CoO 0·26, SnO 0·0[illegible] MgO 23·23, CaO 0·81, Na_2O 1·74, K_2O 0·89, P_2O_5 0·33, Fe 10·80, Ni 0·31, Co 0·0[illegible] S 1·58, P 0·07; sp. gr. 3·734. L. J. S.

Buddhue (John Davis). *Tektites, puzzle of science.* Scientific American, 194[illegible] vol. 164, pp. 354–356, 4 figs.

A popular article, mentioning the several theories on the origin of tektites. L. J. S.

La Paz (Lincoln). *On the origin of tektites.* Pop. Astron., 1944, vol. 52, pp. 194–199; Contr. Soc. Res. Meteorites, [1945], vol. 3 (for 1944), pp. 137–141.

It is unlikely that an australite of 31 grams, said to be an observed fall [M.A. **6**–106], would have penetrated the ground to a depth of 30 cm. [M.A. **7**–269–272]. A second 'observed fall' of an australite [M.A. **7**–381] is also discredited. Some other supposed glassy meteorites are ascribed to the burning of straw stacks [or are slags]. The suggestion that tektites are impactites from the fall of meteorites on the moon [M.A. **8**–63, 379] is criticized. The possibility of such an escape from the moon is admitted, but any such falls on the earth would have a random distribution in time and space; whereas it is maintained that tektites all fell at one period in the past and on three (or possibly more) great circles on the earth [M.A. **7**–275]. L. J. S.

VALD (Jan). *Meteorické sklo.* [Meteoric glass.] Praha (Česká Akad.), 1942, 96 pp., 5 pls. (Czech with English summary.)

he meteoritic origin of tektites is supported, and the view that their surface rkings are due to etching by humic acids or other agents subsequent to their f is rejected. Specimens identical in chemical composition from different lities are corroded in very different ways. Two fragments (figs. 74 and 75) nd 200 metres apart at Habří, west of České Budějovice, show surface mark- s that fit together precisely. The principal factor causing fine holes, pits, oves, and fringes was the pressure of incandescent gases, which also cut into material, disrupting the bombs into fragments. Two maps show 46 localities in Bohemia, 12 in Moravia) and the tektites from each are described. Contrary . Hanuš [M.A. **3**–537], the author supports the view that the Moldavian tites were the first formed at higher temperatures, the Bohemian ones later, that all belong to the same meteoritic fall in the late Miocene period. [M.A. **6**–7–77.] F. S.

MAN (C.). *Über den falschen Tektit aus Källna in Schonen.* Bull. Geol. Inst. Univ. Upsala, 1941, vol. 28, pp. 3–16, 2 figs.

Paper printed in 1938 and presumably then issued separately, but volume dated 1. [M.A. **8**–63.] L. J. S.

AMONY (A.). *The magnetic behaviour of a tektite.* Proc. Indian Acad. Sci., Sect. A, 1944, vol. 20, pp. 15–17.

The magnetic susceptibility of a tektite (sp. gr. 2·448, n 1·535) from Billiton, s found to be $7{\cdot}78 \times 10^{-6}$ per gm. at 25° C., and an X-ray photograph showed o be amorphous. The content of ferrous oxide calculated from the susceptiy is 5·8 %. F. A. B.

UCHÉ-SKADDING (R. J. de). *Discovery of ancient magic stone of the Orient.* Bombay, reprint, 8 pp., 2 pls. (Read at Bombay Branch Royal Asiatic Society, April 10, 1944.)

Billitonites collected by the author on the island of Billiton, Dutch East Indies, identified with the ancient 'agri mani' or 'fire pearl', and mention is made of ne of the many legends relating to it. L. J. S.

CROIX (Alfred). *Tectites du Cambodge.* Compt. Rend. Acad. Sci. Coloniales, Paris, 1932, vol. 12 (for 1928–29), pp. 377–378.

A brief general account. [M.A. **4**–122; **5**–18, 303; **6**–17, 209.] L. J. S.

YER (H. Otley). *Philippine tektites and the tektite problem in general.* Ann. Rep. Smithsonian Institution, Washington, 1943 (for 1942), pp. 253–259.

Reprint of a paper previously published [M.A. **7**–548]. L. J. S.

KER (George) & FORSTER (H. C.). *The specific gravity relationships of australites.* Amer. Journ. Sci., 1943, vol. 241, pp. 377–406, 9 figs.

The sp. gr. of more than 1000 australites were determined and discussed tistically in tables and graphs. Values range from 2·305 to 2·510 with the mean 10. Those from Victoria are slightly lighter than those from Western Australia,

suggesting a progressive difference in chemical composition with increasing silic... Fusion experiments at 4000° C. show an increase of 0·03 in sp. gr., suggest... a volatilization of heavier constituents, and further suggesting that the fall ... falls occurred from west to east. Flanges have a slightly lower sp. gr. than co... [M.A. **7**–79.] L. J. S.

Baker (George). *Flanges of australites (tektites)*. Mem. National Mus. Victo... 1944, no. 14, pp. 7–22, 3 pls., 3 text-figs.

A detailed description is given of the different forms of flanges on australi... mostly from Port Campbell, Victoria [M.A. **7**–79]. Good photographs of t... sections show complex flow structures in flanges and cores. The glass of flan... is isotropic, *n* 1·510, with occasional birefringent bands of *n* 1·535, and min... glass inclusions of *n* 1·460. The mean sp. gr. of flanges, 2·385 (range 2·31–2·44)... lower than that of cores, 2·426 (2·34–2·49), suggesting that the flanges are ric... in silica. It is suggested that the flanges were formed by the flow of plastic gl... during flight through the earth's atmosphere. L. J. S.

Suess (Franz Ed.) [1867–1941]. *Der Meteorkrater von Köfels im Ötztale*. Verhan... III. Internat. Quatär-Konferenz, Wien, 1938, pp. 167–168.

A discussion of the development of the 'crater' at Köfels, Tirol [M.A. **6**–401; **7**–75, 275], attributed by Suess to the impact of a meteorite in late-glacial time... C. F. D.

Krinov (E. L.) Кринов (Е. Л.). Метеоритные кратеры на острове Сааре... (Эзель).—*Meteorite craters on the island of Oesel*. Изв. Акад. Наук СССР... Сер. Геогр. Геофиз. (Bull. Acad. Sci. URSS, Sér. Géogr. Géophys.), 194... vol. 9, no. 4, pp. 409–414, 5 figs. (English summary, p. 414.)

A general account is given of the Kaalijärv craters in Estonia [M.A. **5**–17, 301; **7**–73, 274, 546; Min. Mag. **25**–75]. A list is given of six other authentic meteorit... craters in other regions. No craters were formed by the fall of the Tungusk... meteorite in Siberia in 1908. L. J. S.

Cooke (C. Wythe). *The origin of the Carolina bays, by Douglas Johnson*. (Di... cussion.) Amer. Journ. Sci., 1943, vol. 241, pp. 583–589.

Review of the book [M.A. **8**–378], with criticism of physiographical detail... '. . . the ghost of the meteorite hypothesis should be laid once and for all'... [M.A. **6**-16.] L. J. S.

McCampbell (John C.). *A geomagnetic survey of some Bladen County, Nort... Carolina, "Carolina Bays"*. Journ. Geol. Chicago, 1945, vol. 53, pp. 66–67... 1 fig. (map).

—— *Meteorites and the "Carolina Bays"*. Pop. Astron., 1945, vol. 53, pp. 388... 392, 1 fig.

Magnetic 'highs' close to the bays and the overlapping of rings support th... meteorite hypothesis. [M.A. **8**–378.] L. J. S.

LEY (E. B.). *Meteorites or springs as geological agents?* Nature, London, 1944, vol. 154, pp. 383–385, 1 fig.

The various theories on the origin of the Carolina 'bays' are reviewed. That of Johnson [M.A. **8**–378] is modified with the suggestion that the artesian springs may have come up along earthquake fissures. L. J. S.

INTOSH (R. A.). *The origin of the lunar features.* Journ. Roy. Astron. Soc. Canada, 1943, vol. 37, pp. 24–28.

It is suggested that the maria and larger craters were formed by the fall of meteorites while the surface of the moon was still plastic, allowing some penetration before explosion. [M.A. **8**–62, 197.] L. J. S.

RSHALL (Roy K.). *The origin of the lunar craters.* (*A summary.*) Pop. Astron., 1943, vol. 51, pp. 415–424, 2 figs.

A review of the literature, which is considered to be more in favour of the meteoritic theory, particularly that of H. G. Tompkins (Journ. Brit. Astron. Assoc., 1937, vol. 37, p. 161) of collapsed laccoliths, evidence of which is seen as domes on the moon's surface. 'The hypothesis of meteoroidal impact must be considered seriously challenged because of the failure to observe impact phenomena on the moon today, probably due to the presence of a thin, but effective, lunar atmosphere.' L. J. S.

NINGER (H. H.). *Meteorites and the moon.* Sci. Monthly (Amer. Assoc. Adv. Sci.), 1943, vol. 56, pp. 259–266.

The volcanic theory is rejected, and the meteoritic theory is supported for the origin of the craters and other features. It is suggested that the large maria were formed by the bombardment of a swarm of meteorites (comet?) producing melting and flooding of the surface. [M.A. **7**–76.] L. J. S.

EY (Willy). *Experimental moon craters.* Pop. Astron., 1944, vol. 52, pp. 278–283, 6 figs.

Repeats the experiments of A. Wegener (1921). A spoonful of cement powder or plaster of Paris is dropped from a height of a few feet on a bed of cement powder. With a thin layer of the latter a central peak is formed in the crater. L. J. S.

OOKE (R. D.). *More experimental moon craters.* Pop. Astron., 1945, vol. 53, pp. 76–78, 4 figs.

Miniature (2–25 mm.) craters showing many of the features of lunar craters were formed by dropping powder from a height of 10–20 inches on a bed $\frac{1}{2}$ inch thick of powder. The material used was a very fine glass powder used for enamelling on metals. Less success was obtained with various other kinds of powder. L. J. S.

PURR (J. E.). *Geology applied to selenology. The Imbrian Plain region of the moon.* Lancaster, Pennsylvania, 1944, viii+112 pp., 4 pls., 23 text-figs. Price 18*s*.

The craters and other features are attributed to volcanic action and tectonics. The bright streaks radiating from some craters only are attributed to deposits of ash [M.A. **7**–76]. A short addendum gives biased references to the meteoritic hypothesis. L. J. S.

Haas (Walter H.). *Concerning possible lunar meteoric phenomena.* Pop. Astron., 1943, vol. 51, pp. 397–400; Contr. Soc. Res. Meteorites, [1944], vol. 3 (for 1943), pp. 98–101.

Two faint specks of light moving short distances (18 and 63 miles) across the surface of the moon were seen by two observers in 1941 and 1942. It is suggested that these were due to meteors in a rarefied atmosphere. L. J. S.

Miscellaneous

Lebedev (V. I.). *Chemical formulae of tourmaline, axinite and dumortierite.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1945, vol. 47, pp. 635–639.

New analyses of tourmaline (10 from Transbaikal and 2 from Karelia) by N. V. Lebenfish (1928) give the formula $H_2B_2Al_4Si_4O_{18}.2{\cdot}2$–$3{\cdot}6RO$. With the same nucleus the formula of axinite is written as $H_2B_2Al_4Si_4O_{18}.2Ca_2SiO_4.2(Fe,Mn)SiO_3$, and of dumortierite $H_2B_2Al_4Si_4O_{18}.2Al_2SiO_5.4Al_2O_3$. Graphical formulae show this nucleus built up on two kaolinite nuclei, which offers an explanation of the weathering of these minerals. L. J. S.

Barsanov (G. P.). *Ampangabeite from the Yelisseyevka deposit (Ukrainian SSR).* Compt. Rend. (Doklady) Acad. Sci. URSS, 1945, vol. 48, pp. 128–131.

A brownish-yellow metamict mineral occurring with columbite, gahnite, bismuthinite, &c., in albitized pegmatite was provisionally referred to betafite but the following characters point to ampangabeite. It has the form of small grains or imperfect rectangular prisms (orthorhombic or tetragonal), sp. gr. 3·92 (after ignition 4·0), H. 4–4½, isotropic, n 1·89–2·00 (after ignition, n 2·06), $\gamma-\alpha$ 0·01). Microchemical tests showed Nb–Ta, Fe, Yt–Er, U, H_2O, with less Ti, Ca, Ce–Th, Mn, Pb. L. J. S.

Palache (Charles). *Crystallography of calcite from Lake Superior copper mines.* Amer. Min., 1944, vol. 29, pp. 35–48, 12 figs.

Supplementary to the author's 1898 paper, giving 138 crystal-forms (32 of which are new) found on nearly 200 crystals. L. J. S.

Kašpar (Jan Václav). *O chemickém složení brushitu z Jihokarpatského krasu.* [On the chemical composition of brushite from the karst of the southern Carpathians.] Věstník Geologického Ústavu pro Čechy a Moravu (= Věstník Státního Geol. Ústavu Československé Republiky), 1941, vol. 16 (for 1940), pp. 55–62, 1 pl., 2 text-figs. (With German abstract.)

Brushite from the Domica cave in Slovakia [M.A. **6**–138] gave P_2O_5 40·62, N_2O_5 0·20, FeO 0·03, MgO 0·25, CaO 32·45, H_2O 26·15 = 99·70. F. S.

Čeleda (Jiří) & Kroha (Rudolf). *O horkých pramenech západně od Torfajökull na Islandě.* Rozpravy České Akad., 1939, vol. 49, no. 10, 22 pp., 2 pls., 3 text-figs.

Kroha (R.) & Čeleda (J.). *On the hot springs west of Torfajökull in Iceland.* Bull. Internat. Acad. Tchèque, 1940, vol. 40 (for 1939), pp. 70–85 (English abstract).

Directly above the palagonite and liparite are three layers: (1) blue-grey pyritic, (2) white, (3) surface weathering. The waters of the springs are strongly acid (pH 2·7–4·0). Analysis of the alteration product in (1) gave FeS_2 28·86%,

d a partial loss of SiO_2, RO, R_2O_3. In (2) the pyrite is oxidized, the waters come less acid, and SiO_2 is deposited as opal. In (3), where the springs meet face waters, limonite, opal, and sulphate efflorescences are formed; the last nsist for the most part of halotrichite ('hversalt'). F. S.

ANKAMA (Kalervo). *On the use of the trace elements in some problems of practical geology.* Compt. Rend. Soc. Géol. Finlande, 1940, no. 14 (Bull. Comm. Géol. Finlande, no. 126), pp. 90–106, 1 pl.

— *Über eine neue Prospektionsmethode.* Geol. Rundschau, 1940, vol. 32, pp. 575–578, 1 fig.

Examples are quoted of the presence of certain metals in the ash of plants wing near ore-deposits; e.g. the ash of *Viola calaminaria* from the waste heaps zinc mines contains several per cent. of ZnO. The ash of various plants around kel deposits in Finland contains 0·001–0·5% NiO, and a plot of equal per-tages around the deposit corresponds very closely with the plot of the magnetic vey. Ash of plants near a blende and galena deposit contained > 1% ZnO. sults were obtained even when there was a cover of glacial debris; and this thod of geochemical prospecting may be applied to the mapping of covered cks. L. J. S.

AHAMA (Th. G.) & VÄHÄTALO (Veikko). *X-ray spectrographic study of the rare earths in some Finnish eruptive rocks and minerals.* Compt. Rend. Soc. Géol. Finlande, 1941, no. 14 (Bull. Comm. Géol. Finlande, no. 126), pp. 50–83, 22 figs.

The amounts of 16 rare-earths were determined in various rocks and in onazite, sphene, and apatite. L. J. S.

AHAMA (Th. G.), RANKAMA (Kalervo), & HEINÄSUO (Voitto). *Röntgenspektrographische Bestimmung des Tantals.* Compt. Rend. Soc. Géol. Finlande, 1943, no. 15 (Bull. Comm. Géol. Finlande, no. 128), pp. 21–33, 5 figs.

ANKAMA (Kalervo). *The niobium and tantalum content of three Finnish Archaean granites. (A preliminary report.)* Ibid., pp. 34–39. [Preprints dated 1941.]

— *On the geochemistry of tantalum.* Bull. Comm. Géol. Finlande, 1944, no. 133, 78 pp. 1 fig.

Tantalum, precipitated by phenylarsonic acid and separated from Ti, Zr, Hf, n with salicylic acid, is estimated by X-ray spectroscopy. A very large number f minerals and rocks of various types were examined. Three Archaean granites ntained Nb_2O_5 0·0100, 0·0045, 0·0011; Ta_2O_5 0·0026, 0·0021, 0·0002%. The verage for igneous rocks is Ta_2O_5 0·00026% with Nb/Ta about 9·5. Rather rger amounts are present in granite-pegmatites and nepheline-syenite-pegatites, in which rocks Nb-Ta minerals (list given) are usually found. L. J. S.

RÄMETSÄ (Olavi), SAHAMA (Th. G.), & KANULA (Viljo). *Spektrographische Bestimmungen an Rubidium und Caesium in einigen finnischen Mineralen und Gesteinen.* Compt. Rend. Soc. Géol. Finlande, 1943, no. 15 (Bull. Comm. Géol. Finlande, no. 128), pp. 80–86.

In granites Rb_2O 0·1–0·3, Cs_2O nil; in microclines Rb_2O 0·1–0·3, Cs_2O 0·001–·006; in phlogopites Rb_2O 0·1–1·0, Cs_2O 0·03. L. J. S.

Sahama (Th. G.). *Spurenelemente der Gesteine im südlichen Finnish-Lappland.* Bull. Comm. Géol. Finlande, 1945, no. 135, 86 pp., 12 figs.

Spectroscopic analyses of a collection of rocks (granite, gabbro, amphibolite, quartzite, schists, &c.) show the predominance of Ti, Mn, Yt, Sc, Cr, V, Ni, Co, B in rocks of basic types, and of Zr, Ba, La, Ce, Nd, Be, Rb, Li, Pb in acidic types, in conformity with results obtained in other regions. L. J. S.

Rankama (Kalervo). *On the geochemical differentiation in the earth's crust.* Bull. Comm. Géol. Finlande, 1946, no. 137, 39 pp.

In a series of 18 tables the determined amounts collected from the literature of the following elements present in granites are arranged in order of geologic age: Li, Be, B, Rb, Cs, Ba, Ra, Sc, Yt La, Ce, Nd, Zr, Th, V, Nb, Ta, Cr, Mo, Ga, Ge, Pb. 'Granitophil' elements, Li, Be, Rb, Cs, Ba, rare-earths, Ta, Pb, tend to increase in amount in the younger rocks, while 'granitophobe' elements, Yt show a decrease: this suggests a global migration of elements in the earth's crust. L. J. S.

Borovick (S. A.) & Ratynsky (V. M.). *Tin in coals of the Kuznetsk basin.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1944, vol. 45, pp. 120–121.

Spectroscopic analysis of the ash showed 0·001–0·03% Sn. [Goldschmidt & Peters, M.A. **5**–402.] L. J. S.

Vinogradov (A. P.) & Borovick-Romanova (T. F.). *On the geochemistry of strontium.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1945, vol. 46, pp. 193–196.

Spectrographic determinations were made of the amounts of strontium (present as celestine) in limestone, dolomite, anhydrite, and gypsum from bore-holes to depths of 250 metres through Lower Permian and Carboniferous deposits near Kazan. L. J. S.

[Malyuga (D. P.) Малюга (Д. П.)] Maliuga (D. P.). *Content of copper, nickel, cobalt, and other elements of the iron family in native waters.* Compt. Rend. Acad. Sci. URSS, 1945, vol. 48, pp. 113–116.

Geochemical migration is considered, and the method of analysis is outlined. Mean values are:

	Co.	Ni.	Cu.
Fresh-water, rivers, and lakes	$4{\cdot}3\times10^{-7}$	$1{\cdot}1\times10^{-6}$	$2{\cdot}0\times10^{-6}$%
Sea-water	$2{\cdot}1\times10^{-7}$	$3{\cdot}4\times10^{-7}$	$4{\cdot}1\times10^{-6}$ "
River-delta silts	$3{\cdot}7\times10^{-3}$	$1{\cdot}1\times10^{-2}$	$3{\cdot}5\times10^{-3}$
Marine deposits	$2{\cdot}5\times10^{-3}$	$2{\cdot}5\times10^{-2}$	$8{\cdot}0\times10^{-3}$
Deep-sea Fe–Mn concretions	$2{\cdot}0\times10^{-1}$	$7{\cdot}7\times10^{-1}$	$2{\cdot}9\times10^{-1}$

L. J. S.

Oftedal (Ivar). *Scandium in biotite as a geologic thermometer.* Norsk Geol. Tidsskrift, 1944, vol. 23 (for 1943), pp. 302–312.

Spectroscopic analyses were made of the biotite, amphibole, pyroxene, and muscovite from a large number of Norwegian rocks. Passing from the high-temperature biotites of basic and intermediate igneous rocks through younger granites to Archaean granites and gneisses there is an increase in Sc from less than

to about 30 grams per ton. With lower temperatures the amount increases, d in the biotite from thortveitite-bearing granite-pegmatite it may be as high 1000 grams per ton. [M.A. **5**–73.] L. J. S.

TEDAL (Ivar). *Enrichment of lithium in Norwegian cleavelandite-quartz-pegmatites.* Norsk Geol. Tidsskrift, 1941, vol. 20 (for 1940), pp. 193–198.

Lithium-bearing minerals are rare in Norway. Spectroscopic analysis showed 1–1·5 % Li_2O in brownish micas, related to zinnwaldite, from cleavelandite-artz-pegmatites in Iveland. Micas from other types of rocks usually ntain < 0·17 %. L. J. S.

TTERSON (Edward M.). *The distribution of trace elements in a Scottish Permo-Carboniferous teschenite and its lugaritic differentiate.* Geol. Mag. Hertford, 1945, vol. 82, pp. 230–234.

spectrographic determinations have been made by R. L. Mitchell of some of e rarer elements in two rocks from a composite teschenite–picrite sill at Salt-ats, Ayrshire. The amounts of some of the trace elements in the lugarite are ry different from those in the teschenite, and the differences are discussed in e light of V. M. Goldschmidt's work on the conditions governing the distribu-on of trace elements in rock-forming minerals. [M.A. **7**–165.] W. C. S.

AGER (L. R.) & Mitchell (R. L.). *Distribution of vanadium, chromium, cobalt and nickel in eruptive rocks.* Nature, London, 1945, vol. 156, pp. 207–208.

The percentages of V, Cr, Co, and Ni present in olivines and clinopyroxenes parated from rocks of the Skaergaard intrusion in Greenland have been deter-ined by spectrographic technique. These preliminary data should help towards understanding of the kind of changes in the trace constituents of rocks 'which cur as a result of strong fractional crystallization differentiation of basic magma'. Min. Mag. **26**–283; M.A. **8**–27.] F. A. B.

OLIBOIS (Pierre) & Hébert (Claude). *Sur la composition chimique des phosphates de calcium naturels.* Compt. Rend. Acad. Sci. Paris, 1946, vol. 222, pp. 569–572.

Spectrographic determination of 32 trace elements in 19 specimens of phos-horite and apatite from various localities. L. J. S.

HRENS (L. H.). *Quantitative spectrochemical examination of the minor constituents in pollucite.* Amer. Min., 1945, vol. 30, pp. 616–622.

Pollucite from Karibib, South-West Africa (I) and from Norway, Maine (II), nd lepidolite from Karibib (III) gave:

	Tl_2O.	Rb_2O.	Li_2O.	Ga_2O_3.	K_2O.
I.	0·011	0·54	0·021	0·0012	0·49%
II.	0·0013	0·23	—	0·0012	0·76
III.	0·021	1·60	—	—	—

he concentration of these elements in relation to their atomic radii is discussed. L. J. S.

Nel (H. J.). *Pollucite from Karibib, South West Africa.* Amer. Min., 1944, vol. 29, pp. 443–452, 2 figs. Correction, vol. 30, p. 644.

Colourless, water-clear pollucite occurs in large amount in pegmatite worked for lithium minerals (lepidolite, petalite, amblygonite) on Okongava Ost farm. Sp. gr. 2·865, n_D 1·5173, n_C–n_F 0·0083. Analysis by C. F. J. van der Walt, SiO_2 45·7, Al_2O_3 17·2, Cs_2O 30·2, Rb_2O+K_2O 1·3, Na_2O 2·8, H_2O 2·66 = 99·86, spectroscopic Tl, Li, Ga, agrees with $Cs_{10}Na_4Al_{14}Si_{34}O_{96}.6H_2O$. Material of grain-size < 0·07 mm. lost most of the water at 200–400°; of grain-size 0·15–0·25 mm. at 300–500°, while only 2·23% was lost during the same time that the finer material lost 2·66%. A comparison with earlier analyses suggests that as a larger caesium atom replaces a smaller sodium atom there is less space for H_2O, and that the end-member of the series is $Cs_{16}Al_{10}Si_{32}O_{26}$. A general formula for the analcime-pollucite series is $Cs_{16-x}Na_{x-y}Al_{16-y}Si_{32+y}O_{96}.xH_2O$. L. J. S.

Nel (H. J.). *Petalite and amblygonite from Karibib, South West Africa.* Amer. Min., 1946, vol. 31, pp. 51–57.

These minerals occur in considerable amounts with lepidolite in pegmatite. The petalite has sp. gr. 2·422, H. 6½, α 1·507, β 1·512, γ 1·518, $2V_\gamma$ 82°, axial plane ⊥ (010), $\alpha : a = 2°$. Analysis by C. J. Liebenberg, SiO_2 77·18, Al_2O_3 16·04, Fe_2O_3, 0·64, MgO 0·26, CaO 0·22, Li_2O 4·36, Na_2O 1·14, H_2O+ 0·40, H_2O- 0·02 = 100·25, agrees with $LiAlSi_4O_{10}$; spectroscopic traces of B, F, Ga, Mn, Cr. The massive amblygonite has sp. gr. 3·085, H. 5½, α 1·594, β 1·608, γ 1·616, $2V_\alpha$ 75°, optical orientation given. Analysis by C. J. Liebenberg, P_2O_5 47·54, Al_2O_3 35·19, MgO 0·33, Li_2O 9·65, Na_2O 0·43, K_2O 0·10, F 5·40, H_2O+ 3·26, H_2O - 0·04 = 101·94, agrees with $LiAlPO_4(OH,F)$; spectroscopic traces of Ga, Ca, Fe, Mn. L. J. S.

Heinrich (E. Wm.). *A second discovery of inderite.* Amer. Min., 1946, vol. 31, pp. 71–76.

A fragment ($3\frac{1}{2} \times 2\frac{1}{2}$ cm.) of a large crystal, presumably from California, is identified as inderite [M.A. **7**–122, 123, 476; **8**–114, 257; **9**–30]. It is triclinic with perfect (010) cleavage and good ($1\bar{1}0$). X-ray photographs give a 8·14, b 10·47, c 6·33 Å., α 96° 56½′, β 106° 28′, γ 106° 3′ ($a : b : c = 0·768 : 1 : 0·604$). Sp. gr. 1·860, H. 3. Optical orientation, α near b, $\gamma : c = -22°$, 2V 63°, negative, α 1·488, β 1·508, γ 1·515. Analysis by F. A. Gonyer, B_2O_3 36·41, MgO 14·70, CaO 0·32, H_2O 48·12, insol. 0·54 = 100·09, agrees with $Mg_2B_6O_{11}.15H_2O$. X-ray powder-data are compared with those for artificial material and the original inderite from Inder, Kazakhstan. L. J. S.

Beliankin (D. S.). *Vishnevite, and not sulphatic cancrinite.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1944, vol. 42, pp. 304–306, 1 fig.

Analyses of sulphatic cancrinite [M.A. **1**-256, **4**–379; Min. Mag. **26**–1] and vishnevite [M.A. **4**–499] show 4·65–6·25% SO_3, with 0·26–3·18% CO_2, whilst analyses of cancrinite show no SO_3 or less than 0·1%. Vishnevite contains 92% of the molecule $3Na_2Al_2Si_2O_8.Na_2SO_4.3H_2O$, while in 'sulphatic cancrinites' there is more of the cancrinite molecule $3Na_2Al_2Si_2O_8.Na_2CO_3.3H_2O$ in solid solution. Below this there is a break in the series, and cancrinite and vishnevite are to be regarded as distinct species. Vishnevite from Vishnevy Mts., Urals, loses 3·51%

H_2O at 150° and 6·71% at 500°, with decrease in sp. gr. 2·328 to 2·306 and ω 1·489 to 1·463. L. J. S.

DORENKO (A. V.). *Picite found in the Kerch iron ores.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1944, vol. 43, pp. 264–266.

Brittle nodules in the friable oolitic iron ore of the Kamysh-Burun mine are brick-red (anal. I; Ia $CaCO_3$ and SiO_2 deducted) or brown-red (II). $2Fe_2O_3.P_2O_5.H_2O$; sp. gr. 2·38–2·40, H. 2, n 1·677 1·680. 22·43% H_2O is lost at 165°. The mineral is compared with picite (A. Streng, 1881) from Eleonora mine, Giessen. It has resulted from the alteration of vivianite or paravivianite through kerchenite to oxykerchenite [Min. Mag. **14**–401, 406; **15**-426]. Other iron phosphates from the same deposits [Min. Mag. **20**–442; M.A. **6**-439, **7**–59].

	P_2O_5.	Fe_2O_3.	FeO.	MnO.	MgO.	CaO.	SiO_2.	CO_2.	H_2O+.	H_2O-.	insol.	Total.
I.	22·56	47·39	—	trace	—	2·39	1·00	0·42	15·21	10·82	—	99·79
Ia.	23·05	48·44	—	—	—	1·91	—	—	15·54	11·06	—	100·00
II.	21·99	47·28	—	0·01	trace	3·17	—	n.d.	24·76		2·12	99·33

L. J. S.

I. RIGORIEV (I. F.). *Danalite in the pegmatites of the Imalka deposit, eastern Transbaikal.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1944, vol. 44, pp. 114–115.

Tin-bearing pegmatites in diorite show in the pegmatitic stage subordinate tourmaline, beryl, zircon, and apatite; in the pneumatolytic stage albite, danalite, garnet, cassiterite, pyrite, and muscovite partly replace the earlier minerals; and in the hydrothermal stage there are small amounts of actinolite, rutile, haematite, sphene, clinozoisite, zoisite, chlorite, and sericite. The danalite, forming 0·05–0·1% of the rock, occurs as reddish-brown octahedra (up to 1 cm.) or as fine-grained aggregates (up to 3 cm.); it is optically isotropic with a brown colour, streak chocolate-colour, H. 5½. Analyses, I by S. Khovansky, II and III by K. G. Chenizov, agree with $(Be,Fe,Mn,Zn)_7Si_3O_{12}S$.

	SiO_2.	FeO.	MnO.	ZnO.	BeO.	S.	Total.	Sp. gr.	n.
I.	32·18	34·23	17·35	1·82	8·05	5·25	102·46	3·44	1·759
II.	32·83	31·36	14·55	3·91	14·46	5·62	'102·75'	3·33	1·753
III.	34·08	30·66	13·28	2·97	16·32	5·61	102·92	3·32	1·752

I, also TiO_2 trace, Al_2O_3 (from enclosed felspar) 2·71, Fe_2O_3 0·22, CaO 0·07, MgO 0·32, $(Na,K)_2O$ 0·18, ign. 0·08. L. J. S.

WOLFKOVICH (S. I.) & BERLIN (L. E.). *Conversion of natural borates into boric acid and fertilizers by the process of phosphate treatment.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1944, vol. 43, pp. 249–251.

Borates of Mg, Ca, Na from the Inder deposit in Kazakhstan [M.A. **8**-341] treated with phosphoric acid yield H_3BO_3 and a fertilizer containing P, B, Mg. L. J. S.

WOLFKOVICH (S. I.) & LOGINOVA (A. A.). *Hydrochloric acid conversion of apatites to fertilizers, rare earths and fluoride salts.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1944, vol. 44, pp. 154–157.

Apatite is decomposed with 15% HCl at 30° C. From the solution Na_2SiF_4 is precipitated with NaCl, and rare-earth phosphates with limestone. One ton of

flotation concentrate of Khibina apatite yielded Na_2SiF_4 42·7 kg., rare-earth phosphates (R_2O_3 40%) 19 kg., and precipitate (P_2O_5 45%) 842 kg. L. J. S.

Bogatsky (D. P.). *The chlorination of garnierite.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1944, vol. 45, pp. 67–68, 1 fig.

An average sample of garnierite from the Tyulenev deposit, Ufaley district, Urals, gave an analysis SiO_2 37·02, Ni[*sic*] 21·8, MgO 12·34, CaO 0·54, loss on ignition 17·8%. Heating this material in a current of chlorine complete decomposition takes place only at 1100–1150° C., but when mixed with carbon at about 800° with volatilization of $NiCl_2$. When the material is reduced before chlorination this is completed at 400–500° and the $NiCl_2$ is then leached out. L. J. S.

Fowler (A.). *A deep bore in the Cleveland Hills.* Geol. Mag. Hertford, 1944, vol. 81, pp. 193–206, 1 fig.

In a deep trial boring for oil in the Cleveland Hills, Yorkshire, dolomites of the Lower Magnesian Limestone contain: inclusions of whitish or bluish-white translucent anhydrite; crystals of anhydrite; cavities lined with celestine and occasionally with baryte and gypsum. Joints in the dolomite are coated with anhydrite and baryte, and in one joint, violet fluorite. Beds of anhydrite with streaks of red marl and red marls with anhydrite and gypsum occur between 3075 and 3192 feet in the horizon of the Upper Permian Marls. The anhydrite in the Magnesian Limestone is believed to be of secondary origin. The only rock-salt encountered was a 19-foot bed at 3243 feet in the Middle Permian Marls. [M.A. **9**–258.] W. C. S.

Iyer (M. R. Anantanarayana). *Chemical non-homogeneity in chromites and its possible usefulness in industry.* Current Sci. Bangalore, 1944, vol. 13, pp. 208–209.

Analyses of the solutions obtained after eight successive fusions of chromite with Na_2CO_3 (with still some remaining undecomposed) showed an increase of Cr/Fe from 1·529 to 4·221. L. J. S.

Lundegårdh (Per H.). *A new occurrence of allanite-bearing pegmatite in central Roslagen, Sweden.* Arkiv Kemi, Min. Geol., 1944, vol. 18B, no. 7, 4 pp., 1 fig. (map).

Grains (6–8 mm.) of allanite occur with garnet, molybdenite, &c., in an andesine-quartz-biotite-pegmatite penetrating ultrabasic gabbro at Grovstanäs. In thin section they are pale grey-green and isotropic, n 1·65, and are rimmed by a brown-red alteration product. L. J. S.

Friedlaender (C.). *Beobachtungen an authigenen Quarzkristallen aus einer tonigen Spaltausfüllung in Gneis.* Schweiz. Min. Petr. Mitt., 1944, vol. 24, pp. 25–29, 3 figs.

Clayey material consisting of sericite and quartz from crevices in gneiss between Albbruck and Dogern [on the Baden side of the Rhine] contains prisms (0·03–0·3 mm. long) of quartz. Often two or three are grouped together at various angles, and some may be twins. Some show undulose extinction and others enclose scales of sericite roughly parallel to the rhombohedral faces. L. J. S.

SCHER (E.). *Über die Kristallform, chemische Zusammensetzung und systematische Stellung des Barthit.* Zeits. Krist., 1944, vol. 105, pp. 268–272, 4 figs.

Small (1 mm.) grass-green crystals of barthite from Guchab, Otavi, SW. Africa in. Mag. **17**–345] are orthorhombic bisphenoidal of prismatic or bisphenoidal bit with $a : b : c = 0{\cdot}648 : 1 : 0{\cdot}832$, and forms (110), (011), (111), (1$\bar{1}$1), (021), 0). 'Rechtsbarthit' and 'Linksbarthit' are sometimes twinned together on 00). The green colour is restricted to a thin outer zone; inside the crystals are ourless and transparent, and contain no copper. Calcium was found in both rtions. Partial microchemical analysis of fragments consisting of both portions ve CaO 22·5, As_2O_5 43·2%, suggesting a formula $Ca(Zn,Cu)(OH)AsO_4$. The erior of the crystals therefore consists of austinite, $CaZn(OH)AsO_4$ [M.A. **6**–53], d the outer part probably of higginsite, $CaCu(OH)AsO_4$ [M.A. **1**–122], both of olivenite group. [M.A. **8**–11.] L. J. S.

LLWELL (F. L.) & EDWARDS (A. B.). *Cobaltite in the Broken Hill lode.* Proc. Australasian Inst. Mining & Metallurgy, 1944, no. 133, pp. 21–27, 1 pl., 1 text-fig.

Cobaltite as embedded crystals and massive occurs with safflorite-löllingite. halysis, after deducting 8·4% insoluble, gave Co 28·9, Fe 6·2, As 45·0, S 19·9. ystals are feebly anisotropic with traces of twin-lamellae. L. J. S.

ASON (BRIAN). *The system Fe_2O_3–Mn_2O_2: some comments on the names bixbyite, sitaparite, and partridgeite.* Amer. Min., 1944, vol. 29, pp. 66–69, 1 fig.

Recapitulating the view of a previous paper [M.A. **9**–32] that bixbyite is the ly name needed for minerals of the composition $(Mn,Fe)_2O_3$. Those of pneu- atolytic or fumarolic origin contain Fe_2O_3 40–60%, while those occurring in etamorphosed manganese ores contain Fe_2O_3 0–30%. [M.A. **9**–4, 5.] L. J. S.

OATS (Robert R.) & FAHEY (Joseph J.). *Siderophyllite from Brooks Mountain, Alaska.* Amer. Min., 1944, vol. 29, pp. 373–377.

A pegmatite sill intrusive into marble on Brooks mountain, Seward peninsula, laska, consists of glassy-grey quartz, greenish-yellow orthoclase, and masses of arse siderophyllite up to 2 inches in thickness containing individual plates up $\frac{3}{4}$ inch across. The blackish green-grey siderophyllite, sp. gr. 3·121, α 1·590, 1·640–1·642, 2V 6–8°, is pleochroic from dark-green to pale straw-yellow, and elds on analysis SiO_2 37·01, TiO_2 0·02, Al_2O_3 15·89, Fe_2O_3 trace, FeO 30·16, nO 1·01, MgO 0·22, CaO 0·10, Li_2O 1·01, Na_2O 0·58, K_2O 9·02, Rb_2O 0·19, Cs_2O 12, H_2O- none, H_2O+ 1·92, F 3·88, Cl 0·24, total 101·37, less O for F, Cl 1·68 = ·69. On calculating the number of metallic atoms for ten atoms of oxygen xact agreement with the biotite type of mica formula is obtained, the actual mposition approaching $KR_3AlSi_3O_{10}(OH)_2$, where R includes two atoms of rrous iron, the remaining being made up of Al, Mn, Li, and Mg. F. A. B.

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